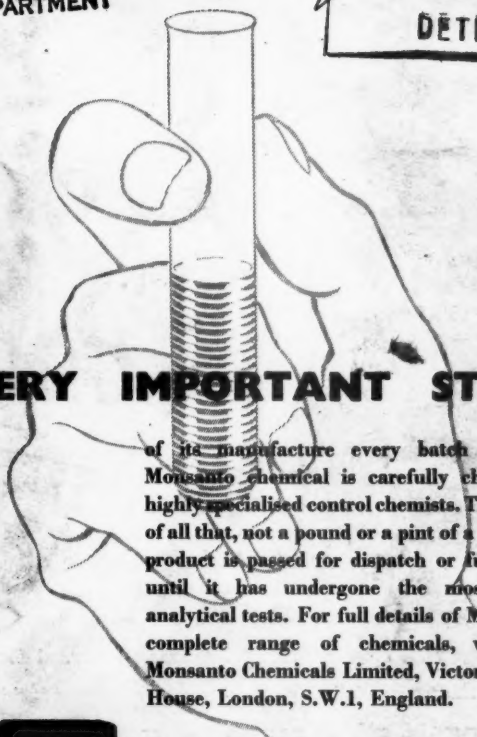
TOBER, 1948 TWO SHILLINGS

Plastics

ALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

TECHNOLOGY DEPARTMENT

OCT 26 1948
DETROIT



AT EVERY IMPORTANT STAGE

of its manufacture every batch of every Monsanto chemical is carefully checked by highly specialised control chemists. Then on top of all that, not a pound or a pint of a Monsanto product is passed for dispatch or further use until it has undergone the most critical analytical tests. For full details of Monsanto's complete range of chemicals, write to: Monsanto Chemicals Limited, Victoria Station House, London, S.W.1, England.

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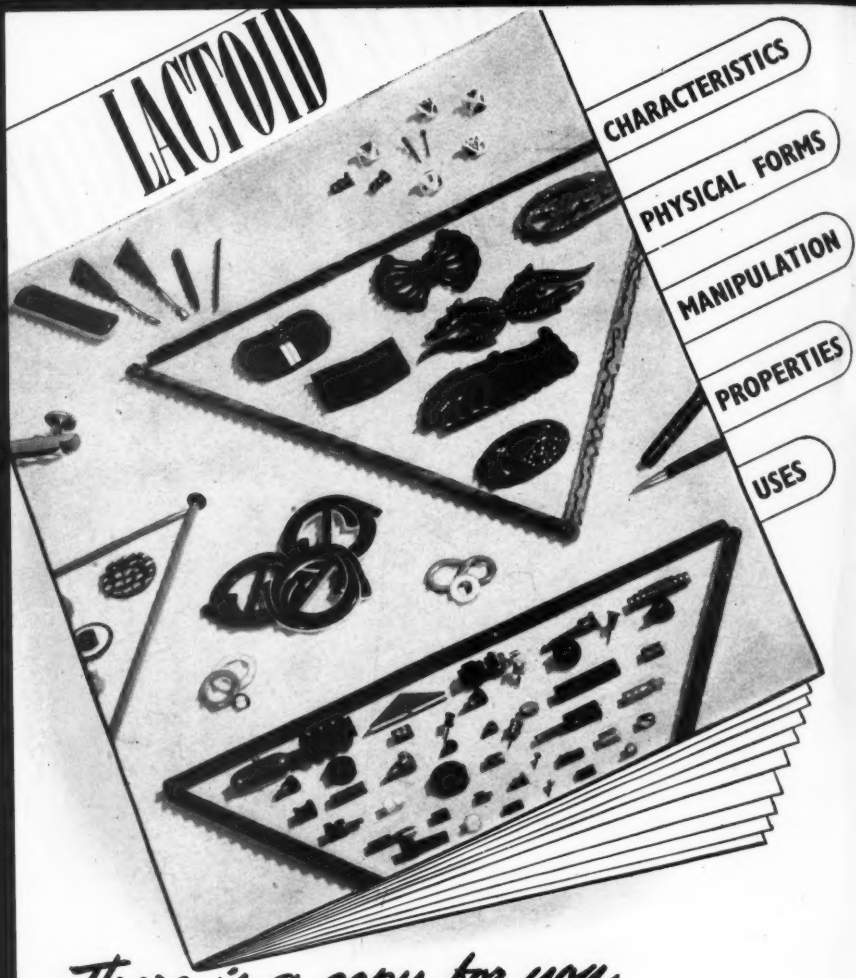
PHENOL . . . CRESYLIC ACIDS . . . PHTHALIC ANHYDRIDE (flake) . . . DIETHYL PHTHALATE . . . DIMETHYL PHTHALATE . . . DIBUTYL PHTHALATE . . . AROCLORS (chlorinated diphenyls) . . . SANTOLITES (speciality resins) . . . SANTICIZERS (speciality plasticisers) . . . FIBESTOS (cellulose acetate) . . . BENZOIC ACID . . . SALICYLIC ACID . . . LUSTRON (polystyrene moulding crystals)

SERVING INDUSTRY WHICH SERVES MANKIND



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A NEW PUBLICATION with all the data most needed by users of Lactoid, *the* casein plastic, concisely presented for easy reference. Illustrations display the superb colours of this versatile BX material, which is now available for prompt delivery. If you use or would like to use Lactoid — just write for your copy.

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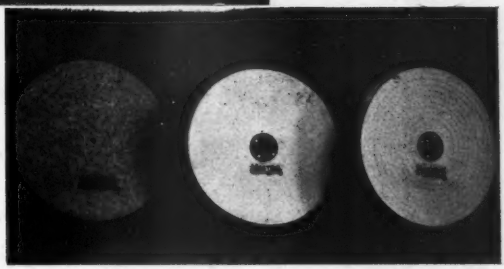

CATALOGUE 'P.61'
ON APPLICATION

MASTRAL
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TRIPLEX first started shaping acrylic Resin sheets in 1936 and can therefore claim to be pioneers in this respect.

TRIPLEX were responsible for 85% of all Perspex mouldings supplied to the Royal Air Force during the war.

TRIPLEX today still offer aircraft precision standards combined with competitive prices and an excellent delivery service.

TRIPLEX carry considerable stocks of raw material and are equipped for flow production on a large scale.

TRIPLEX Plastics division has been extensively reorganised and the many difficulties arising in the change over from war to peace time production have been finally overcome.

TRIPLEX can handle all your moulding and fabricating problems.

Fit "TripleX" PLASTICS and be Safe

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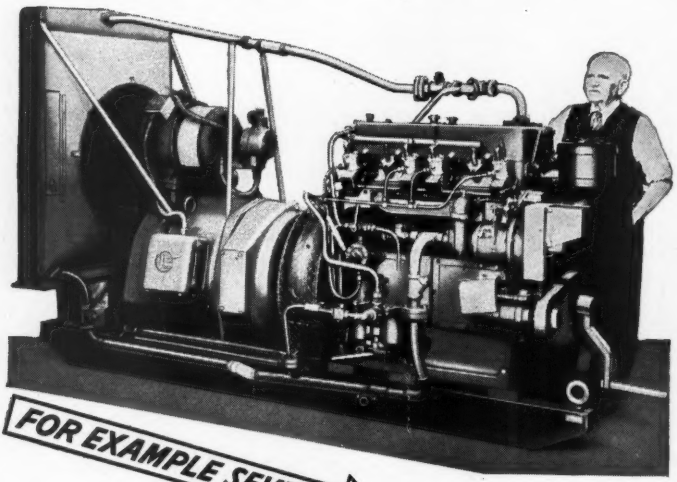
STAND-BY
Electric GENERATING SETS
EX-STOCK



FOR EXAMPLE SEVERAL

similar 45 kVA self-contained Diesel Engine driven ALTERNATOR SETS, each mounted on combined base-plate and direct coupled. They incorporate a radiator fan-cooled, vertical 4-cylinder 4-stroke cycle cold starting Diesel Engine by CROSSLEY, speed 1000 r.p.m. Each is arranged for electric starting complete with starting motor, charging dynamo and batteries and the accessories are—air and oil filters, exhaust silencer, daily service fuel tank; the Engine is directly coupled to a 45 kVA Alternator by ENGLISH ELECTRIC COMPANY for 400 volts, three phase, 50 cycles, 4-wire supply, complete with an exciter which has a direct coupled Isenthal automatic voltage regulator; each set is complete with Generator Panel.

The Government has already said that there will be a worse shortage of Electricity this winter than last.

GEORGE COHEN
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WOOD LANE - - LONDON, W.12
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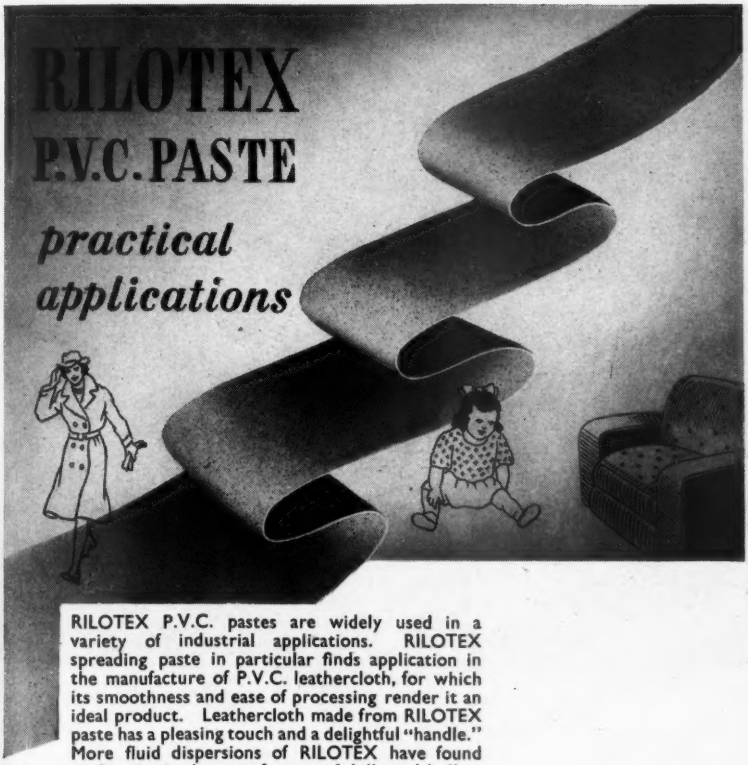
And at Birmingham, Newcastle, Sheffield, Manchester, Glasgow, Dunfermline, Swansea, Southampton, Bath Belfast.

ONE OF THE 600 GROUP OF COMPANIES

488/P/5

RILOTEX P.V.C. PASTE

practical applications



RILOTEX P.V.C. pastes are widely used in a variety of industrial applications. RILOTEX spreading paste in particular finds application in the manufacture of P.V.C. leathercloth, for which its smoothness and ease of processing render it an ideal product. Leathercloth made from RILOTEX paste has a pleasing touch and a delightful "handle." More fluid dispersions of RILOTEX have found application in the manufacture of dolls and hollow toys generally by the casting or "slush moulding" process. Another grade of RILOTEX paste is used for the "stopping off" of electro-plating equipment and sealing of cable connections by a dipping process.

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DUNSTABLE · BEDFORDSHIRE

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CATALIN LIQUID RESINS

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Used as the male or female component of a pressing tool for mild steel, aluminium alloys, etc., Cataform offers many outstanding advantages.

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Aqueous resin emulsion for bonding fibres, pulp, sand, cork, etc., and for stiffening paper or fabric. Available as a core-binding resin for foundries.

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Brush setting cement.

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Cold setting, high strength, adhesive for wood, fabric, plastic mouldings, stressed plywood, etc.

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Hard and quick setting lacquer, providing high gloss finish for furniture, floors, etc. Abrasive resistant; oil, petrol and acid resistant.

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For synthetic lacquer bases and electrical and mechanical laminations.

CATACAST
Cold setting casting resin supplied in a variety of beautiful colours.

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Impregnating resin.

Our research organisation is constantly at work developing new applications for Catalin Liquid Resins. A word from you will bring all its specialised knowledge to bear in solving *your* particular industrial problems, in improving *your* product. Write to our Development and Research Service . . .

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Cast Resin, Synthetic Adhesives and Bonding Resin Manufacturers

Associated Product:

Catalin TRADE MARK REGISTERED is a thermosetting cast phenolic resin, supplied to your own specification, or in rods, sheets, tubes, and special profile sections.

CONVERT YOUR PLASTICS INTO DAZZLING JEWELLERY

BY THE NEW METAPLAST PROCESS

METAPLAST, with its Revolutionary Process of plating metals on to non-conductors, has solved the two major problems of the moulder.

The design that has sold well, but is now encountering sales-resistance, can be re-styled entirely, and the colour range superseded or amplified by a completely new line in gold, silver, chromium or the oxidised finishes, and all on your old plastic base.

METAPLAST will profoundly alter the **DESIGN** of new mouldings, for plastics can enter a vast field traditionally held by metals, in most cases producing a lighter, better, more attractive article without the disadvantages of weight or a base metal liable to corrosion troubles.

FREE TEST OFFER. METAPLAST specialist service will advise **FREE** on drawings, blue prints, sample mouldings, and will produce, on request, a sample plated with the metal desired.

All communications to:

METAPLAST (ENGLAND) LTD., BATH ROAD, HARMONDSWORTH, MIDDLESEX

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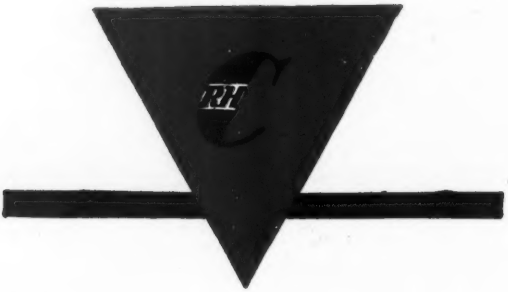

STYRON

Polystyrene Moulding Granules

manufactured by

DOW CHEMICAL OF CANADA LTD.

We are pleased to advise that customers' requirements can now be met in the full range of standard colours

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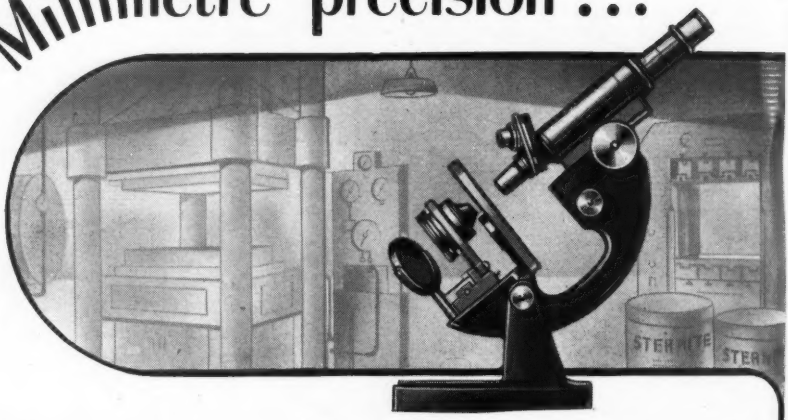
Telephone: MITCHAM 1624, 1625, 1626

Millimetre precision ...



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THERMO SETTING MOULDING POWDERS

PHENOL FORMALDEHYDE. G.P. H.D. & Special Grades
UREA FORMALDEHYDE GRANULAR. All Colours

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Φ P2

Tygan

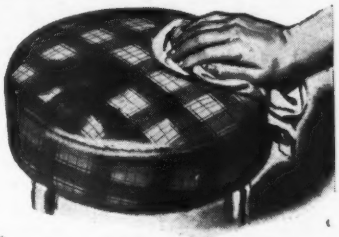
IS TOPS WHERE TREATMENT IS TOUGH

Tygan stands up to the daily grind

Tygan is probably the nearest approach to an everlasting fabric which has yet been devised. Its resilience, toughness and abrasion resistance ensure excellent wearing qualities, where treatment is particularly severe. Water will not rot or weaken it; damp will not cause it to mould; sun will not fade it; and moth will not attack it. Tygan is also exceptionally resistant to acids, alkalis, alcohol and other organic solvents. And it possesses outstanding weathering properties.

Tygan is available in a wide range of attractive colours and designs. It upholsters well, and because it can easily be cleaned by sponging, it keeps its smart appearance.

Tygan is woven exclusively by Fothergill & Harvey Limited from Bexan, a new synthetic yarn developed by B.X. Plastics Limited, and undergoes the same rigorous testing as other Tyga Textiles in their laboratories at Littleborough. This is an assurance of the consistent high quality and serviceability of Tygan, which conforms in every respect to the highest standards of Lancashire woven productions.

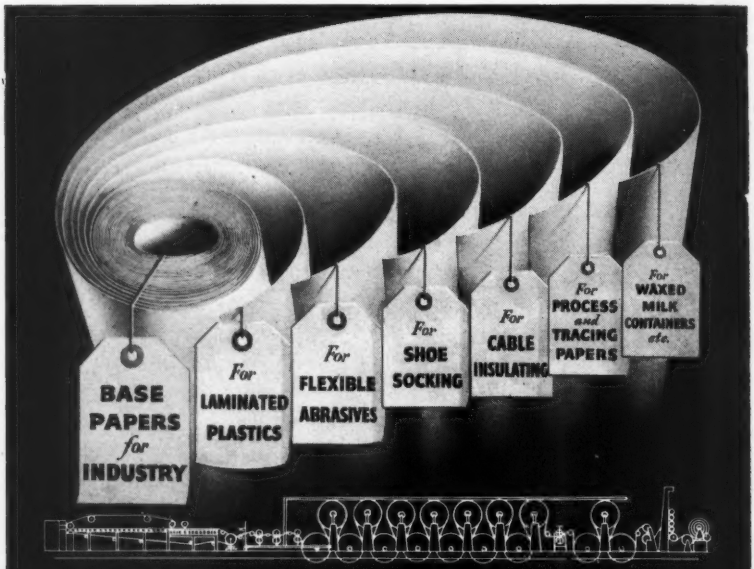


Tygan can be cleaned with a damp cloth

Tygan is woven from BEXAN, a new synthetic yarn developed by B.X. Plastics Ltd.

● *This is one of the advertisements appearing for Tygan in the furnishing trade press*

Write for illustrated folder including patterns, quoting reference Z 4, to FOTHERGILL & HARVEY LTD. Thirty-seven Peter Street, Manchester 2



Here are a few of the special base papers we make for industry. Nearly 200 years of papermaking experience together with extensive modern research and control are behind these and many other papers. This experience and knowledge assure the high quality and regularity of our papers. The good name of your product, whether it be Abrasive Sheet, Milk Container, or Laminated Plastic, relies on the base paper. Although paper is scarce, let us begin research for you now so that when raw materials are more plentiful we shall be ready to give you just what you require for your especial needs.

RESEARCH AND DEVELOPMENT ALWAYS PAY

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FINE PAPER MAKERS
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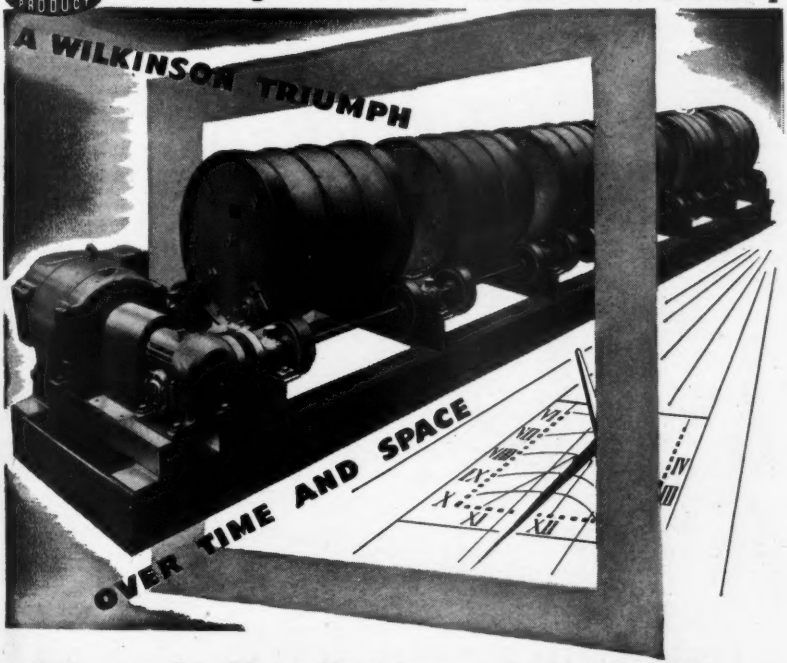
WIGGINS TEAPE
INDUSTRIAL PAPERS

WIGGINS TEAPE & ALEX PIRIE (SALES) LTD, ALDGATE HOUSE, MANSELL STREET, LONDON, E.1

WILKINSON PRODUCT

Making Rubber Serve Industry

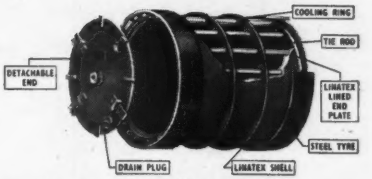


with an in-line Battery of Ball Mills . .

Wilkinson scientists took the toughest natural product in the world, improved it, and gave to industry Linatex 95% pure rubber. Non-absorbent, resilient, extremely light, and resistant to abrasion and corrosion, Linatex made possible revolutions in Ball Mill design. The type 'C' Linatex Ball Mill incorporates direct roller drive, whereby a number of Mills may be driven from one motor . . . saving fuel, labour costs, and space. While the Battery is running, additional drums may be charged, eliminating idle time for man and machine . . . a dual triumph over Time and Space.

UNITS COMPLETE with motor and reduction gear. Replacement drums supplied for existing units. Sizes 8" dia. to 3' 6" dia. Speeds to suit customers' requirements.

LINATEX MODEL 'C' BALL MILL



Employs the same revolutionary principles of drum construction as in Types 'A' and 'B'. Instead of a metal drum lined with porcelain or rubber, the barrel is formed by rings of Linatex 95% pure rubber under compression, securely anchored by embedded tie-rods. Type 'C' permits of an in-line battery of Ball Mills driven off one motor. Each drum has a detachable end plate, which greatly facilitates cleaning out — an important point where a variety of substances requires to be ground.

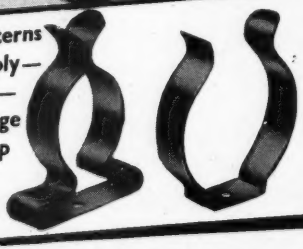
THE **BALL MILL** BUILT WITH **LINATEX** 95% PURE NATURAL RUBBER

Patent No. 576410

All Enquiries to: **WILKINSON RUBBER LINATEX LTD · FRIMLEY ROAD · CAMBERLEY · SURREY**
Tel. Camberley 1595. Also in Canada, Australia, South Africa, U.S.A., Belgium, Holland, Scandinavia, Malaya, etc.
Also Makers of Flexatex Hose, Linatex, and the Linatex Pump

LET TERRY'S SOLVE YOUR *Clip* PROBLEMS

Two stock patterns always in supply—80 and 81—made in a range of sizes to grip from ¼" to 2"



and a CLIP for drawing boards (No. 300)

We show just a few from our enormous selection of specially made clips . . . our research department can design any clip to your own specification (93 years of clip-making is at your disposal)

The most authoritative text book on springs yet published. 10/6 post free.

HERBERT TERRY & SONS LTD. REDDITCH · *London* · *Birmingham* · *Manchester*

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The printing and engraving of plastics material is a speciality we have developed, quite literally, to a fine art. From the manufacture of a complicated calculator to a simple name plate, we pride ourselves that we have considerable experience. Send your problems to us and we will be pleased to let you have the benefit of our 37 years in the industry.

Printing and engraving are by no means our only interest. We also manipulate and fabricate plastics sheet, tube and rod.

U.K. PLASTICS LIMITED, KINGSTON BY-PASS, SURBITON, SURREY

Telephone: Elmbridge 2014-5 Established 1911 Telegrams: 'Celluprint, Surbiton

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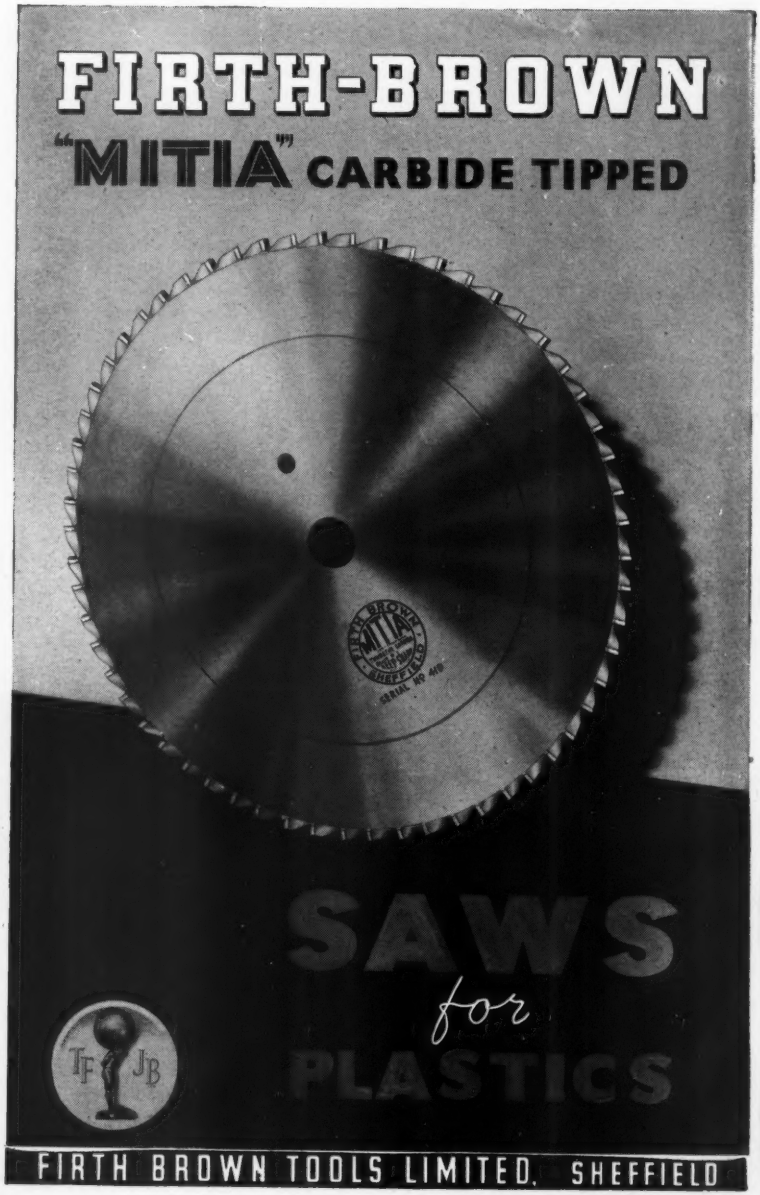
FIRTH-BROWN
"MITIA" CARBIDE TIPPED
SAWS
for
PLASTICS
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FIRTH BROWN TOOLS LIMITED. SHEFFIELD

m and i

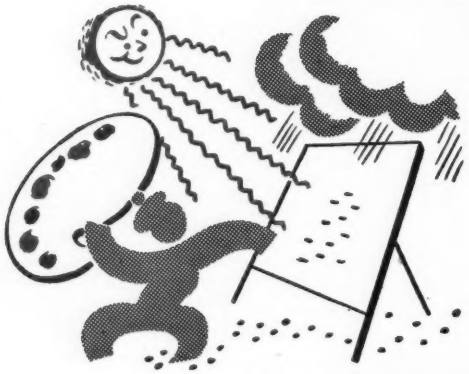
THE MICANITE & INSULATORS COMPANY LTD.

Empire Works, Blackhorse Lane, Walthamstow, London, E.17

Manufacturers of MICANITE (Built-up Mica Insulation). Fabricated and Processed MICA. PAXOLIN Laminated Materials. EMPIRE Varnished Insulating Cloths and Tapes. HIGH VOLTAGE BUSHINGS and TERMINALS. Distributors of Micoflex-Duratube Sleevings and Micoflex-Durasleeve (Plastics-covered flexible metal conduit)

D

THE COLOUR STABILITY OF MONSANTO Lustron POLYSTYRENE MOULDING CRYSTALS IS ENSURED

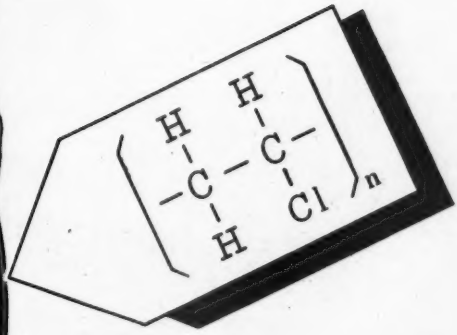


Every dye and pigment used in Lustron is tested for heat and light stability by exposing injection moulded slabs of Lustron containing the colouring matter to the ultra violet light of an Atlas carbon-arc fadeometer. This ensures the light fastness and heat stability of coloured Lustron mouldings.

QUICK FACTS ABOUT LUSTRON . . . Low cost per pound . . . Lightweight . . . Faster moulding . . . New brilliance and clarity . . . No taste or odour . . . High dimensional stability . . . Excellent electrical qualities . . . Gay colour range.

MONSANTO CHEMICALS

Write to Plastics Department, Monsanto Chemicals Limited, Victoria Station House, London, S.W.1.



Two hundred and fifty volts in her hand — *and she's thinking about tomorrow's lunch!* She takes the insulating properties of her vacuum cleaner cord for granted, and well she may. The covering is one of the Geon Polyvinyl Materials — Geon 101 — which has outstanding electrical properties and is easily processed directly on to almost all types of conductors. Please write to us for full information on the properties, processing and supply of Geon 101 — or any material in the Geon range.

Geon
Polyvinyl Materials

GEON 101	Polyvinyl chloride resin
GEON 200 series	Vinyl copolymer resins
GEON 100X210	Vinyl paste resin
GEON Compounds and Pastes	Based on Geon resins
GEON Latex 15X	Modified vinyl latex
GEON Latex 31X	Air-drying vinyl latex
GEON Polyblend	Geon/Hycar blend

Hycar OR 15 and 25 synthetic rubbers and latices

BRITISH GEON LIMITED, SALES OFFICE & TECHNICAL SERVICE: 21 ST. JAMES'S SQUARE, LONDON, S.W.1. TELEPHONE: WHITEHALL 9561 (5 lines). WORKS: BARRY, GLAM.

Hortense — SAID THE MANAGING DIRECTOR —

I must address the people

This old country that we love so well calls on us all for a little more effort. A mere 10% increase in our total production will close the gap, solve the problem and may even enable the price of beer to be reduced and put roast pork back on the menu. Can we get that extra 10% ? Of course we can! In thousands of assembly shops for instance millions of hours are wasted fiddling around with tiddley screws and nuts which a Power Tool would deal with in a tenth of the time.

call up the LITTLE horses

Specialists in Lightweight Pneumatic and Electric Portable Tools.

DESOUTTER

IF you are concerned with assembly work write to me. Tell me your troubles and I shall be surprised if we can't find an answer. Write at once—all of you. *We* will provide the tools—*you* will get on with the job—and prosperity (so far as I am concerned anyhow) will really be just round the corner.

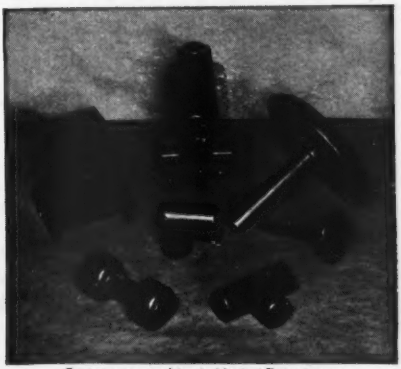
DESOUTTER BROS. LTD., THE HYDE, HENDON, LONDON, N.W.9. TELEPHONE : COLINDALE 6346-7-8-9

C.R.C.189

TELCOTHENE
REGD.
THERMOPLASTIC MOULDINGS

TELCOTHENE—a thermoplastic material having a polythene base—can be profitably utilised where superior electrical characteristics and chemical inertness are required. In addition, the properties of low moisture permeability, mechanical robustness, particularly at sub-zero temperatures, and the absence of toxic fillers make it a desirable product in many industries.

Moulded insulators in natural "TELCOTHENE" incorporate metal inserts.



Components moulded in black "Telcothene"

Bottles, funnels, beakers, etc., for laboratory use.

TELCON

THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD.
Founded 1864

Head Office: 22 OLD BROAD ST., LONDON, E.C.2
Telephone: LONdon Wall 3141

Enquiries to: TELCON WORKS, GREENWICH, S.E.10
Telephone: Greenwich 1040

SHELL AIDS TO PROCESSING

Methyl Ethyl Ketone

● METHYL ETHYL KETONE is a colourless, mobile liquid with a characteristic ketonic odour, possessing a moderately low boiling point, a lower rate of evaporation than acetone and good solvent power. It is inert towards metals and does not hydrolyse to acidic products which might give rise to corrosion problems.

METHYL ETHYL KETONE is an excellent solvent for cellulose nitrate, for low viscosity grades of cellulose acetate and for many natural and synthetic resins, especially the soluble vinyl types—which makes it of particular interest in the formulation of surface coatings based upon polyvinyl acetate resins and co-polymers.

Shell METHYL ETHYL KETONE is manufactured to a high degree of purity and conforms to the following specification :

PURITY	Minimum 99% by weight.
SPECIFIC GRAVITY	0.805—0.807 at 20/20°C.
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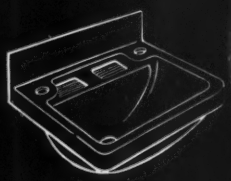

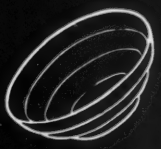

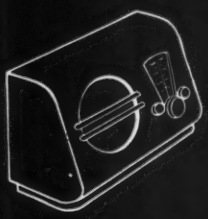

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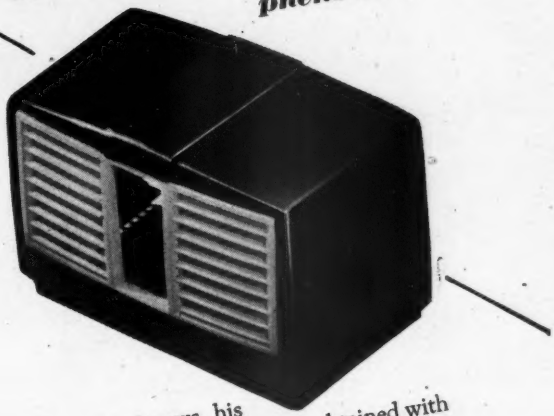

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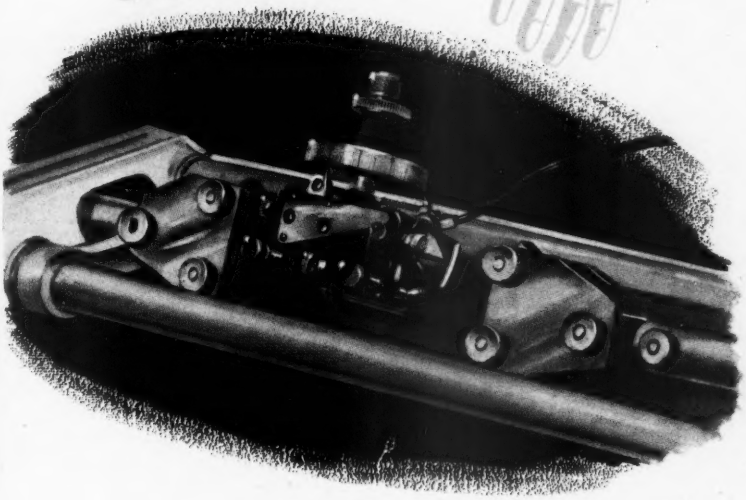

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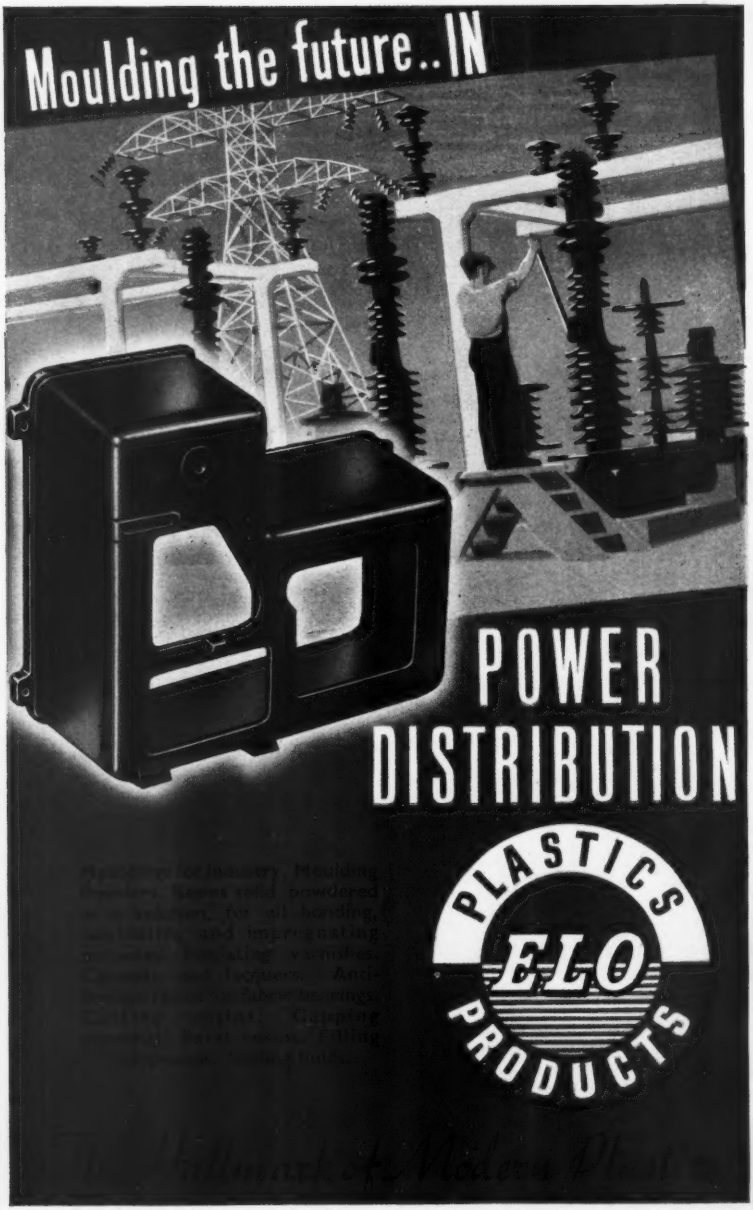

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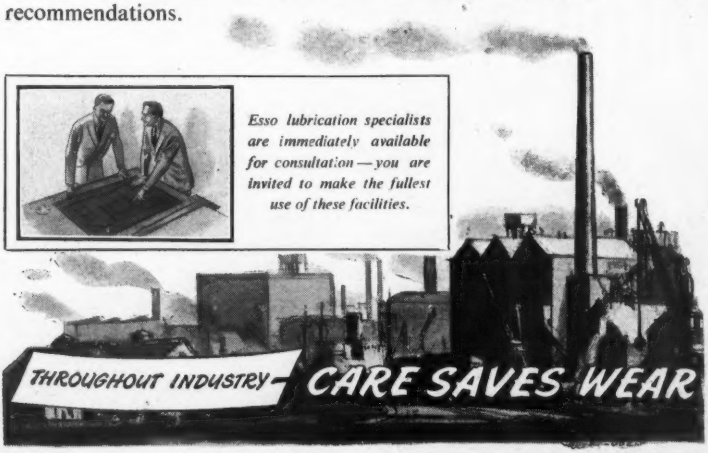

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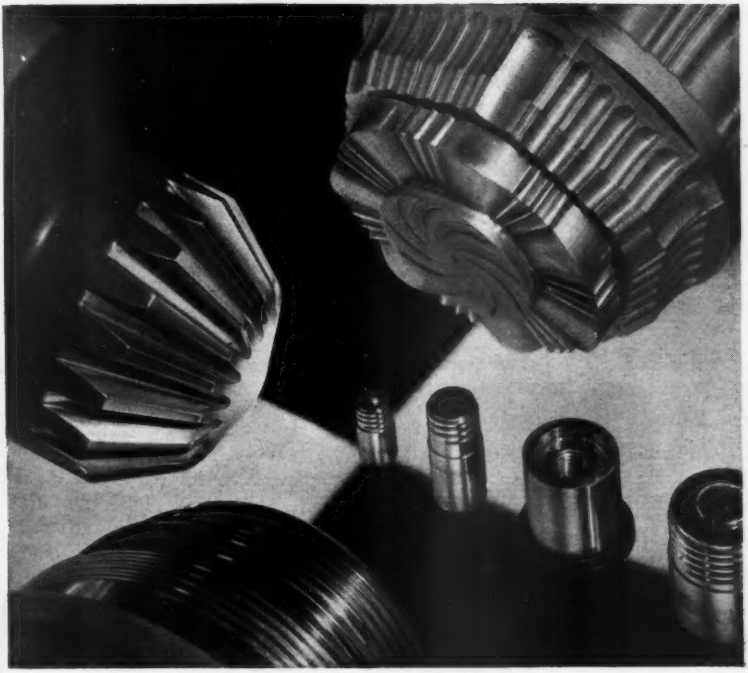

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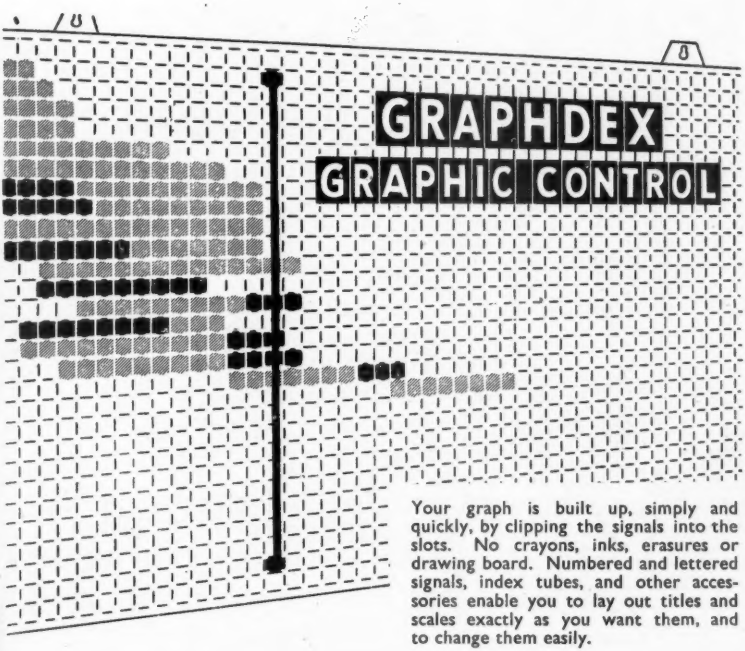

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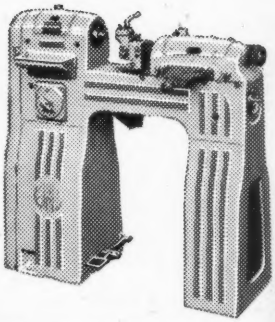

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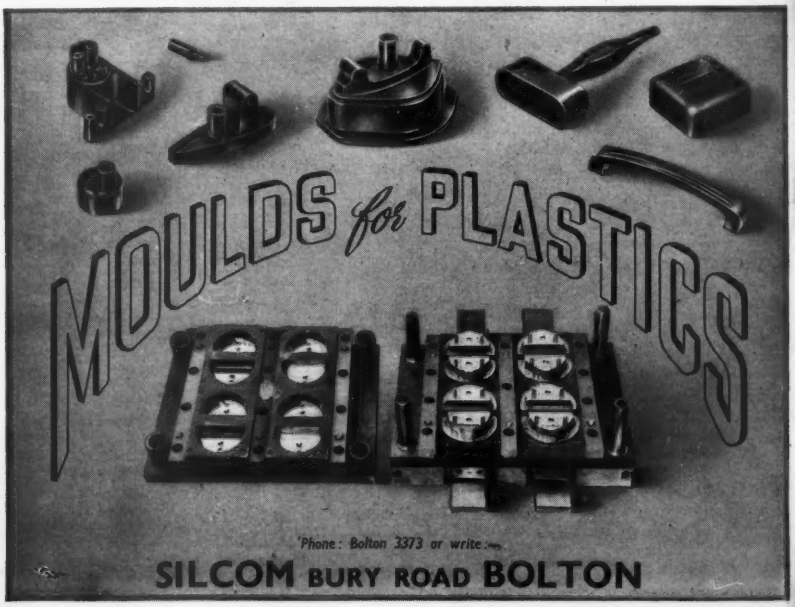

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Vol. XII. No. 137 OCTOBER, 1948

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - **TEMPLE PRESS LIMITED**
Chairman and Managing Director **ROLAND E. DANGERFIELD**

Editor - - - **M. D. CURWEN, B.Sc., A.R.I.C.**
Offices - - **Bowling Green Lane, London, E.C.1**

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NOTICES

"PLASTICS" is published monthly in London, England.
Annual subscription rate 26/-. Shorter periods pro rata.

All instructions, matter and passed proofs of all kinds of advertisements must reach the Head Office of "PLASTICS" by the 24th of preceding month to ensure insertion.

Head Offices:
Bowling Green Lane, London, E.C.1.
Inland Telegrams - - "*Pressimus, Phone, London.*"
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EDITORIALS

Large Injection Mouldings

TWO very recent announcements regarding large-capacity injection machines take the plastic story in this country another step forward and beg the question "Whither Plastics?" which, like most broad questions on science, can be answered only the day after to-morrow. One announcement made in this Journal by British Moulded Products, Ltd., was to the effect that a 24-oz. injection machine had been erected in the works. It is probably the largest installed in Great Britain. The second announcement was by A. C. Wickman, Ltd., of Coventry, giving details of the new 40-oz. H.P.M. injection machine and thus indicating its availability here.

The pace has been set in the U.S.A. where, as we learned from Islyn Thomas's monumental work, numbers of machines ranging from 12 to 36 oz. capacities have been installed and that one special job is being produced by injecting 80 oz. on modified standard equipment. What a vast change there has been during even the past decade! Ten years ago the 1- and 2-oz. machine ruled the roast in Europe and even at the Leipzig Fair in 1939 the medium-sized machine was conspicuous by its absence. The first large-capacity machine was built exactly 10 years ago in the U.S.A. as a result of the introduction of multifeed jets.

Taken by and large the injection machine then was considered an instrument for the production of fancy goods, small toys and other small objects, this idea being tied up with the difficulty of producing larger dimensionally stable mouldings within the compass of the machine and with the early thermoplastic moulding powders.

The coming to this country in the early 1940's of the medium type, by which we mean those of 4 to 8 oz. capacity, was not hailed with unmixed delight. Many manufacturers regarded them askant, considering them only as potential producers of larger numbers of small objects in one cycle. The future of such machines in a country with a population of only 45,000,000 was entirely different from the possibilities in the U.S.A., with 3-4 times that number of people, and indeed highly problematical. Where, it was asked, was the business to come from? On the whole this faulty conception soon gave way to a truer understanding of the functions of large machines and although both here and in America they were often used with multi-impression moulds for small articles (it was not an edifying sight to see small combs being made on an 8-oz. machine), experience was also gained in the production of what then were considered large mouldings.

This experience was of the utmost significance for it led also to the entry into fields hitherto considered even often outside any other existing method of production because of the necessity of characteristics present only in thermoplastics. Thus larger injection mouldings, many of complicated form, were produced variously for the electrical, radio, automobile and engineering industries. Boxes, portable-radio cabinets, brush-backs and large tool-handles, large textile bobbins and clock cases are now quite common.

To-day, with the advent of the "giants," the modern factory contains a range of injection machines, each it is true of considerable flexibility and overlapping yet segregated in its maximum capabilities from the others. Each, in fact, has its proper function as limited by size of moulding and by economic production.

Thus the thermo-plastic section of the industry now stands on a par, so far as its tools are concerned, with the thermosetting industry and more closely to the

metal industry; it can tackle fields that only a few years ago were considered completely out of its reach.

Workers in the 1950s may yet consider the new machines small beer, but to us at any rate they are milestones in plastic history.

American Experience

THE story of the large machine has recently been retold in the U.S.A. with considerable enthusiasm and knowledge by Mr. G. W. Whitehead at the 1948 annual meeting of the Society of the Plastics Industry, in New York.

He described the great difficulties and successes of the designers of the plant and of the mould makers in attaining heating cylinder efficiency and bringing the plastic to the die in a completely satisfactory condition. In mould making itself great advances have been made in proper channelling for temperature control, "knock-out" control, gating and ribbing for strength and ribbing for flow, while design of cross-sectional thickness is of prime importance, since flow becomes more significant on large pieces. He told, too, of the part played by raw-material selection, for the larger the piece, the greater the care needed in selecting for distortion, shrinkage and strength. The material manufacturers to-day supply their materials in pellet form, which has been a major factor in contributing to the success of larger mouldings. Constant research has provided great improvements in heat and colour stability, flow characteristics and strength.

Mr. Whitehead concluded by answering the question: "Are there any tricks in injection-moulding large pieces?"

He thought there were no more than those in the production of small pieces, for the moulding of large pieces has become a science. More care must be taken in handling the equipment and material. Closer control of all factors influencing moulding must be made. Conditions of pressure, heating-cylinder temperature and die temperature must be accurately controlled, material must be carefully preconditioned and care taken against contamination. When a moulded piece is removed from the mould it is quite warm. The factor of uniform cooling becomes a more serious problem with large pieces than with small ones. Frequently it is necessary to utilize cooling or shrink fixtures to prevent distortion. Still again, it has been found desirable to drop the pieces into water at some predetermined optimum temperature, often in conjunction with shrink fixtures. Assembly of large pieces likewise becomes a problem.

What is being made on these machines in the U.S.A. was described with the aid of actual samples, of which the following are outstanding.

Crosley Refrigerator Corporation drip baffle of polystyrene is made in two pieces, each weighing 30 oz. and having a projected area of 360 sq. ins.; made on a 28-oz. machine. Cycle, 85 secs.

Nash Kelvinator Corporation evaporator door, weighing 12 oz., with a projected area of 120 sq. ins.; made on a 16-oz. machine.

Admiral Refrigerator freezing-unit door of polystyrene weighing 14 oz.; made on a 16-oz. machine. Cycle, 45 secs.

Seat cover weighing 32 oz.; moulded on a 22-oz. machine. Cycle, 3 mins. Automatic double loading before injection. Material: Cellulose aceto-butyrate.

Auto Photo Co. developing tanks of maximum weight 18½ oz. with 2½-min. cycle and made from polythene on a 16-oz. machine.

Gun stock of cellulose aceto-butyrate weighing 13½ oz.; made on a 16-oz. machine.

P.80 aircraft battery case of polystyrene; made on a 16-oz. machine equipped with pre-plasticizing unit. Weight of moulding was not given.

Protein Fibres

THE recent propaganda broadcast in the Press and on the air regarding the development in East Africa for the production of the ground or pea-nut, brings

into prominence the possibility of augmenting and improving still more our man-made fibres. Primarily the ground-nut scheme is an attempt to augment the world's fat requirements, but it is also true that large surpluses were available from India and West Africa before the war. There is little doubt that here we have ample supplies "in normal times" for the extraction from the nut, after oil has been removed, of a protein that has already proved itself of first importance as a high-class fibre.

Protein fibres, from which we exclude natural wool and refer only to the "man-made" type, are not, in fact, synthetic fibres as "synthesis" is meant by the chemist. The latter as typified by nylon, vinyon, Terylene, polyvinylidene chloride, etc., which are completely chemical productions, find their beginnings in simple chemical compounds. Protein fibres, like protein plastics, such as those made from casein (from milk), zein (from maize), soya bean, keratin from horn and that from pea-nut meal, obtain their raw materials sometimes by simple and sometimes difficult separations of the proteins already existing as such in the naturally occurring vegetable or animal matter indicated; little change is made in these raw materials chemically to produce a fibre therefrom. Each and all of these proteins are assuming great importance, or at least will grow in importance as normal conditions are created throughout the world. It is a considerable error to presume that the truly synthetic fibres will oust from the world either the truly natural fibres or those protein fibres derived from other sources. Each may, and often does, possess characteristics different from others and eminently desirable, while economics may, in turn, have its say in the matter of large-scale production.

This is indicated in a valuable report recently published by the Director of the Museum of Technology and Applied Science, Sydney, Australia, on "Plastics and Synthetic Fibres." Writing of the production of casein fibre from skimmed milk in the United Kingdom and in Italy, and its softening effect on coarse-grained wool, the author sees nothing fantastic in the possibility of Australia being forced at some future date to make this protein fibre under pressure of economics. He also tells of soya bean fibres made both in Japan and the U.S.A., and of economically possible protein fibres from feathers and egg waste!

To return to our own problem, British manufacture from pea-nut protein, Imperial Chemical Industries, Ltd., have planned to spend £500,000 on "Ardil" made in Scottish factories. What this will mean to our economics is given in the statement that a 50-50 mixture with wool is indistinguishable from all-wool articles.

While scientists all over the world are trying to create new large synthetic molecules for fibres and indeed "tailoring" them to reproduce desirable characteristics such as high resistance, "warmth," etc., all agree that in many natural substances we have large ready-made molecules which it would be folly not to employ.

Welcome visitor from New Zealand is Mr. A. C. Morcom Green, of Morcom Green and Edwards, Ltd., Onehunga, Auckland. He is here to study the utilization in this country of synthetic glues, of the spraying of plastics and other coating problems. He leaves again by air early in November.

There's a Tavern (de luxe) in the Town

WHILE I should have liked to try my hand at a philosophic discussion on the art of drinking in comfort, perhaps this is neither the time nor the place; moreover, it would entail a rabid denunciation of the discomforts and dangers of swallowing a pint of bitter in the "Dog in the Manger," in Fleet Street, surrounded by a maddened herd of thirsty Englishmen in search of like sustenance. Instead, I shall tell of a little place at the foot of Monte Carlo in the street of Grimaldi which is deserving of special mention in The Delectable Story of Wines and Other Liquors.

I had known Madame, the proprietress, in a previous incarnation and already knew of her work in the cause of the amity of nations. During my present visit I noted that she had invested in a new set of tables for both the outside and inside of her establishment. Gone were the inch-thick solid marble tops and cast-iron ornamental supporting bridge-work of Second Empire design that weighed tons, required a major transport operation each morning

and night to remove, and reduced poor old Emile, the handyman, to a state of collapse. Instead, I saw a range of delightful cream-coloured laminate-topped tables with scarlet legs that brought joy to the eye, quiet to the heart and an irresistible desire to rest awhile with Madame's soul-sweeteners.

"Five thousand francs, each table-top alone, they cost me," and she waved her mutton-leg arms to bring Heaven to witness her truth and the iniquity of modern prices. "But," she added, "it is worth while. So gay, so practical, so light and so clean!" And she wiped away a non-existent speck of dust from the immaculate surface. "Regard," she said, "it does not stain with the alcohols; not even with 'Tordboyaux.'"

I did not like this "even," as this less-known elixir of life is my favourite and I was about to consume my quota of it. True, it has the kick of a youthful mule, and the comic papers say the manufacturers guarantee a minimum 8 per cent. nitric acid content; but I like it.

Meditatively, I spilled a drop or two on the table. It bored no hole through the table-top, nor were any nitrous fumes evolved. The creamy smooth surface remained virginal. It had passed the supreme test.

I leaned back contentedly and through half-closed eyes watched the white sails flapping into Monaco port and the gulls sweeping lazily and heavily in the hot, lowering sun.

Bring me, chère Madame, four liqueurs —a pale-green Chartreuse, an orange-coloured Grand Marnier, a nut-brown Vieille Cure and the yellow Izarra from the far-off Basque country. For the rest of this beautiful evening I shall concern myself solely in the pursuit of knowledge and in contemplating this table. Who knows, I may yet contribute a learned paper on the subject to the members of the Plastics Institute. M.D.C.

"British Plastics Year Book 1948."—We have known this catalogue now for nearly 18 years, and it has gone on its useful, unpretentious way ever since with steady improvement. We say "unpretentious" because it does not purport to be more than a catalogue, which, after all, is what we want from a catalogue, and not, in addition, a learned work on the chemistry, physics and engineering of plastics and its raw materials, which is already available in text books.

All workers in the field, or those proposing to enter it, require lists of raw material, machinery and finished goods manufacturers. Nothing else is really essential in a catalogue, although we willingly stretch a point on certain specialized lists.

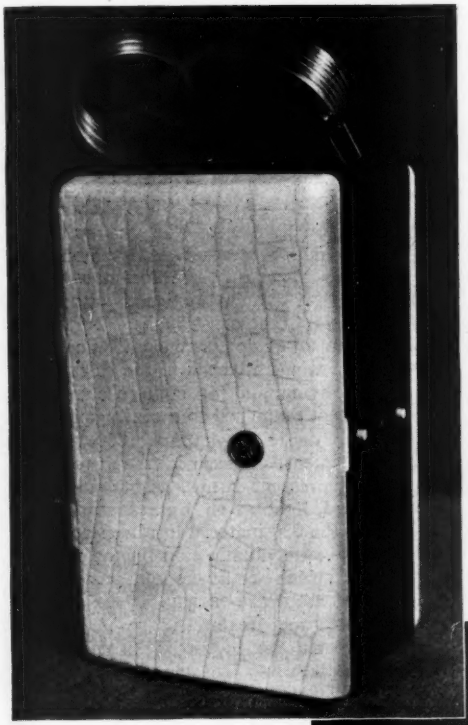
"The British Plastics Year Book" fulfils these duties very well. It is divided into 10 sections, easily and quickly "get-at-able" by the use of extended named and numbered finger tabs (which might, however, be strengthened for a complete year's hard wear). The sections are: 1, Patents and B.S. Specifications; 2, Raw Materials; 3, Manufactured Products; 4, Plant; 5, Glossaries (Trade Names and Technical Terms); 6, Names and addresses (of all manufacturers under 2, 3 and 4); 7, Who's Who in the Industry; 8, Associations and Federations; 9, Technical Data. Thus, in 2, 3, 4 and 6 we have the most important sections, and in 8 information regarding the internal structure of the industry and of its related bodies. Under 6 we note the important inclusion of consultants, industrial designers, research organizations, education (all establishments) and world periodicals: all sound meat.

A weakness is probably Section 5, which gives trade names and also technical terms. A complete list of trade names is almost impossible, so that large lacunæ exist. The technical-terms section is probably even weaker, for it is contained in 10 pages, when 100 pages are necessary.

It seems also a general habit in catalogues to include a section which tells us the number of inches to a foot or metre, the areas of circles and the number of gallons per hour delivered by pumps of various sizes. Surely every technical man has an engineering or chemical handbook on his desk?

However, these criticisms, except where they indicate a waste of valuable paper, are but slight. The British Plastics Year Book is a useful, handy compilation of the right size, which all workers in the industry should possess. It is published by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, at 30s.

Personal Radio Case



The front and back covers of this Stromberg-Carlson personal radio, complete with plastic carrying strap, have an attractive crocodile-skin finish on the brown cellulose acetate material. Convenience and smartness are the main points of the design. The crocodile-skin effect is machined upon the mould which is employed. The moulds were made by Casolin Pty., Ltd., of Pine Street, Chippendale, Sydney, New South Wales. (Australian Official Photographs by J. D. Band.)

Applications of Acrylic Plastics in Lighting

Acrylic plastics are among the more important of new materials now being used in the construction of fittings for artificial lighting. In common with almost every constructional material, however, they have properties which limit their application in this field of engineering, yet the boundaries defined by these limitations are especially wide, and within them many types of equipment are efficiently serving the artificial lighting industry. At the recent Summer Meeting of the Illuminating Engineering Society, Dr. W. E. Harper, A.M.I.E.E., and Mr. H. P. Walker, both of I.C.I. Plastics Division, jointly presented a most comprehensive paper upon this subject, from which we give extracts by kind permission of the Council of the Illuminating Engineering Society. Those readers who wish to refer to such parts of this paper as relate to the physical and mechanical properties of the acrylic plastics, and fabrication techniques, will find the complete paper published in Trans. Illum. Eng. Soc. (London), 1948/13/147.

THE actual applications of acrylic sheet in lighting fittings are extensive and varied. The first acrylic plastic unit to be extensively made for industrial and commercial lighting was a trough reflector for fluorescent lamps, using the 020 opal sheet; ⅛-in. material of this grade was a very suitable reflecting medium, as it had a sufficiently high reflection factor to give downward light practically equivalent to that of enamelled reflectors, with sufficient transmission to provide adequate ceiling illumination. The actual balance of downward and upward light depends to some extent on the method of shaping. In general, the downward component comprises about 85 per cent. and the upward component 15 per cent. of the light output of the fitting. This type of unit has advantages when compared with a similar type of trough in enamelled steel, as good ceiling illumination is gained with little loss of downward light, the absorption losses of flat acrylic sheet being only about 8 per cent. compared with 15 to 20 per cent. in most enamels.

Tests of acrylic reflectors over periods of more than three years have shown exceptionally good maintenance of light output due to the negligible change in reflection factor of the material with time in all atmospheres. Among the various types of reflector now made, each with its own particular advantages, are: (1) Complete troughs; (2) troughs with metal or opaque ends; (3) units with plastic wings attached to the sides of the centre spine; and (4) single reflectors with open ends attached to a centre spine.

The dense acrylic opal 060 has not been extensively used in trough reflectors for fluorescent lamps, as the additional upward light given by reflectors made from the 020 material has been preferred to the extra illumination on the working plane which would be obtained by the use of the dense variety.

Both opal materials are now being considered for industrial dispersive-type reflectors, using tungsten lamps. One of the chief difficulties in this application is the high temperature reached in the region of the reflector neck, particularly when the unit is enclosed with a diffusing bottom plate. Encouraging results have, however, been obtained with 14-in. reflectors for 150-watt and 200-watt lamps with both ventilated and enclosed galleries.

The advantages offered by the acrylic opals in reflecting units are resistance to damage by impact and general handling, maintenance of light output during life, resistance of the reflecting surface to corrosion, including freedom from discoloration, and low absorption giving a reasonable ceiling illumination with a good illumination on the working plane.

The introduction of the high transmission diffusing opal 030 should help to fulfil the demands of those who require a diffusing medium for use with fluorescent lamps. Its diffusion is suffi-

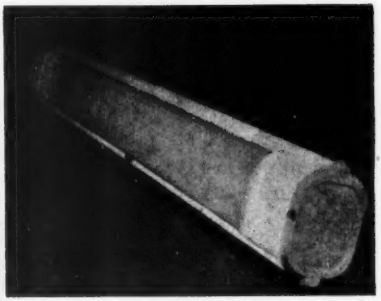


Fig. 1.—Corrosion-proof fitting for 80-watt fluorescent lamp.

cient to flash the aperture of a normal diffusely reflecting trough, while its transmission is high enough to prevent a "dead" appearance. This material is likely to replace sand-blasted materials, as it does not suffer from "finger-marking."

For more decorative commercial units use is made of clear material with some surface-diffusing finish. Most popular of these appear to be designs using machine-fluted transparent sheet. Fluted material of this nature is, perhaps, less efficient than the high-transmission acrylic opal, but is sometimes preferred as the internal reflections give an attractive sparkle when compared with the comparatively plain surface illumination of the diffuser.

Corrosive Situations in Industry

In many industrial situations damp, acid-laden atmospheres cause corrosion of most metals and destroy vitreous and stove-enamel finishes through attack on the metal base. Particularly subject to this trouble are fittings used over acid pickling vats and in dye works. An acid-proof fitting expressly designed for service in such conditions is made in acrylic sheet, the top half being in reflecting opal and the bottom half in clear material. Fittings of this type (Fig. 1) have been in service for a considerable time in a large chemical factory and show no deterioration in atmospheres that ruined normal fittings in a few months.

Street Lighting

The first large-scale application of acrylic sheet in street lighting was in fluorescent lanterns. Here a large transparent area was essential and, owing to the fitting dimensions, glass was difficult to apply. Acrylic sheet appeared to meet most of the designers' requirements, and its heat transfer being low, in cold weather it helps to maintain the internal temperature of the fitting at a level which enables the lamps to function with reasonable efficiency. A possible new development is the substitution of a blown or pressed bowl for the plain bends now generally used.

The comparatively low operating temperature of sodium vapour lamps has suggested that acrylic materials might be used in various types of fittings. Following initial experiments, a 45-watt asymmetrical unit (Fig. 2) was made almost wholly from acrylic sheet. A shaping for the faceted wing-type reflector was formed by blowing $\frac{1}{8}$-in. sheet into a metal mould of required contour, the shaping being subsequently metallized. Many experiments, however, were necessary before a satisfactory moulding was

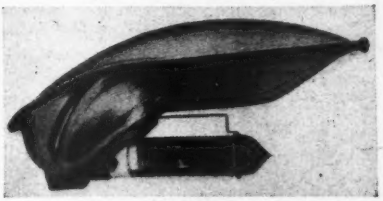


Fig. 2.—Sodium street-lighting lantern, 45/60-watt, with mirrored acrylic reflector and opal cover.

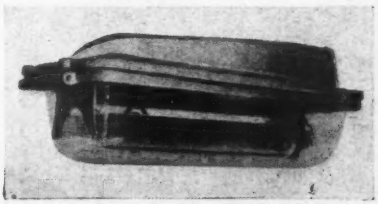


Fig. 3.—Sodium street-lighting lantern (140-watt) with enclosing dish moulded from acrylic sheet.

obtained, particular difficulty being caused through the formation of unwanted ridges in the material during the shaping operation.

Experiments in high-pressure moulding have shown that prismatic patterns can be reproduced with high accuracy on acrylic sheet. Temperature investigations indicated that their demoulding temperature was likely to be higher than that encountered in most sodium lanterns. Sample refractor plates have been produced and prism accuracy is of a high order. A plate with enclosed prisms can be made by cementing a thin sheet over the prisms to a suitable edge pressed in the plate for this purpose. As these plates are easily cemented to another piece of the material, it seemed possible that a transparent prism "cover slip" could be made, which would be an integral part of the lantern and eliminate the necessity for metal frames. This finally led to the design of an enclosed sodium lantern consisting primarily of an acrylic sheet dish and cover carried from a simple casting. The cover for this unit is made from the reflecting opal 060, and has advantages of lightness, complete enclosure of the lamp, high and consistent prism accuracy and general resistance to corrosion. Long-term exposure of this dense opal material indicates that in some situations there may be slight pigment migration on the exposed surface, but this does not affect the performance of the fitting. New materials being developed should overcome all such chalkings.

Lighting in Coal Mines

Some years ago a suggestion was made that a plastic material might be used for the transparent part of flameproof mine-lighting fittings, but it was then thought that it would not be suitable due to surface softness and dust collection caused by induced static charges. The development of coal-face lighting, and particularly the introduction of the fluorescent lamp, led to a request for transparent enclosures capable of resisting breakage by impact and satisfying

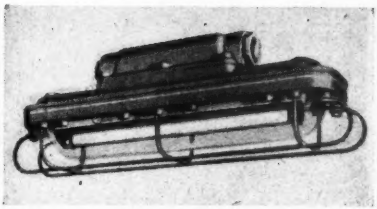


Fig. 4.—Mine-lighting fitting with moulded acrylic covers.

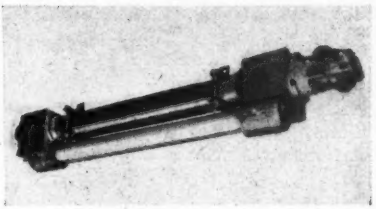


Fig. 5.—Mine-lighting fitting with cast acrylic tube enclosing fluorescent lamp.

the other requirements of B.S. 889. It seemed that acrylic mouldings could meet these requirements, and tests were commenced, particular attention being paid to abrasion and dust collection, as these were recognized limitations of the material.

Shapings of normal types in which the material had not been thinned to less than ¼-in. passed B.S. 889 quite easily, so a trial in service conditions was made. Six bends in ⅜-in. sheet were placed at the coal face within about 3 ft. of the shot-blast holes. At this distance flying stones from the shot explosion give a severe blow, often on a very small area. The bends survived for several weeks in these conditions, and, as a final test, were placed within 18 ins. of a shot hole in which heavy charges were fired. Even in these conditions only two of the bends cracked, and it was concluded that the strength of the material was ample for the purpose.

In the next trial six bulkhead fittings with dome covers were made by blowing from ⅜-in. material, the stretch of the blowing reducing the thickness to ¼-in.

at the top of the dome. These fittings were used with 60-watt lamps and five survived a long test period without damage.

The first units to be put into actual service were equipped with 15-watt or 20-watt fluorescent lamps, one fitting using a dish-type cover and the other an acrylic tube (Figs. 4 and 5). The first unit was moulded from ⅜-in. acrylic sheet and fixed into the casting with "Kaffir" cement, the fixing bolts passing through the flange of the dish. Fittings of this type, installed at Chislet Colliery, have given over six months' service. Examination after the first test period of three months showed that there had been no breakage, that surface abrasion was slight, and that surface pitting was negligible. It was noticed also that, despite the dusty atmosphere of the coal-face area where the tests were made, there had been no obvious collection of dust due to static charge. The tubes in the second type of unit are made either by fabrication from sheet or by centrifugal casting. The dish fitting gave slightly better distribution, but the tube units were cheaper in construction and easier to render flameproof.

German practice during later years for both coal-face and roadway lighting tended toward the use of opal enclosures for filament lamps as the glare from bare lamps or refractor units was considered objectionable. The introduction of high-transmission opal acrylic sheet has enabled a ⅜-in. thick material to be made, giving good diffusion, coupled with a transmission of the order of 60 per cent. It is thought that, as this material withstands the necessary impact tests, it may find use in filament-lamp fittings. However, care will be necessary in design to prevent demoulding.

Experiments have also been made in the pressing of refractor dishes for tungsten mine-lighting units. These mouldings have been successful, but again care must be taken in their use, otherwise demoulding of the prisms occurs.

Fig. 6.—Tramcar fitting for 15-watt fluorescent lamp, using machine-fluted acrylic cover.

Rail and Road Transport

Transport lighting demands a material able to withstand the vibration and weave associated with trains and road vehicles, the problem being accentuated by the introduction of fluorescent lighting. Acrylic sheet has been extensively used in American train lighting and is now receiving attention from British designers. Several transport lighting installations have been completed and various types of fittings used, the simplest and probably the most serviceable being that for tramcars (Fig. 6). Here simple fittings consisting of ribbed bends enclose 18-in. 15-watt fluorescent lamps and are housed in light sheet-steel surrounds, being easily removed for cleaning. For railway-carriage installations, advantage has been taken of the flexibility of the sheet to construct fittings without hinges, the bends being sprung into position.

Due to breakage of road bollard signs, both from accidental and malicious causes, tests have been made in the use of plastic materials. Here, owing to its good dimensional stability and high impact strength, acrylic sheet was found to be most serviceable and is coming into considerable use. Lettered signs of the "Keep Left" type are prepared by stencilling or silk-screening the lettering on the back of the clear acrylic sheet, which is then coated with a white diffusing paint, often followed by a protective clear lacquer. To give reasonable safety from damage by flying stones material ⅜-in. thick should be used.

(*Continued on page* 524).

World's Industry Employs Plastics

GENERAL ENGINEERING

Metal coatings can be applied to plastics by three different methods: Electroplating, vacuum evaporation, and metal spraying. H. R. Clauser discusses and compares these methods. ("Materials and Methods," 1948/June/79.)

Resin coatings on zinc.—For improving the adhesion of synthetic resin finishes upon zinc a chromate solution containing formic acid has been used as a dip after zinc plating. ("Materials and Methods," 1948/May/83.)

Hardness testing.—The application and significance of hardness tests, in particular indentation tests on plastics, is discussed by V. E. Lysaght. ("Materials and Methods," 1948/May/84.)

Rubber as an engineering material is surveyed by K. Rose, who shows how the basic properties of the material may be changed through various additions and changes in processing. ("Materials and Methods," 1948/May/93.)

Vulcanized fibre.—G. H. Albert reviews the many mechanical and electrical components which can be made of vulcanized fibre. ("Materials and Methods," 1948/Apr./88.)

Plastics and metal.—Various interesting manufacturing methods are applied at the Scintilla Magneto-Division of Bendix Aviation Corp., Sidney, N.Y., regarding the continued use of plastics, rubber, and metal parts. The main materials used are phenolics and hard synthetic rubbers. ("Materials and Methods," 1948/**27**/67.)

German plastics.—An article in "Kunststoffe" (1948/May-June/100) surveys the work done in the "Kunststoffe-Rohstoff Department" of Badische Anilin and Sodafabrik, Ludwigshafen, which was founded in 1938. Materials developed by this concern include Igelit, Polystyrol, Acronal, Acronex, Igevin, Oppanol, Igamid, Palatinol, Palamoll and Plastomoll.

MISCELLANEOUS

Wall tiles.—Laminated tiles in the form of a semi-rigid lamination of phenolic and melamine plastics (produced by Leathertone Inc., Medford Street, Boston, U.S.A.) are fixed to the wall by liquid cement which dries after 20 minutes. A special compound kneaded into rolls closes the gaps. Material withstands heat up to 275 degrees F. ("Business Week," 1948/July 3/50.)

Safety spectacles.—New safety spectacles (Chicago Eye Shield Co., 2,300, Warren Str., Chicago, 12) with a single-piece plastic lens, forehead rest, and balanced temple suspension, weighs only 1 oz.; they are fitted over ordinary spectacles and can be supplied with either clear or glare-reducing green plastic lenses. ("Products Finishing," 1948/May/123.)

Plastic covering provided by vinyl resins Geon and Saran proved to be very successful in America in the battle against corrosion. ("Wat. Works Engineering," 1947/Feb./200.)

Tool protection.—A new lacquer on nitrocellulose basis for the protection of machine tools against corrosion has been

developed in the Russian machine-tool plant of M. Gorki : it consists of 35 per cent. nitrocellulose, 20 per cent. camphor, 5 per cent. drying oil and 40 per cent. acetone. (" Stanki i. Instrument," 1948/Feb./25.)

Attack by fungi.—Experiments on the treatment of cork with salicylanilide as fungicide have been reported. High heat and long baking times lowered the fungicidal properties; a baking time above 4 hrs. at 125 degrees C. cannot be recommended. (" Product Engineering," 1948/June/107.)

Plasticizers.—K. Thinius reports on plasticizers for linear polycondensates based on a detailed survey of the patent literature (" Kunststoffe," 1948/May-June/108.)

Film measurement. — Thickness of Phofilm sheets is measured by use of the radioactive isotope C^{14}, a by-product of atomic energy plants; an accuracy of 1/100,000 in. is attained. The isotope in question is said to be one of the weakest, and no special protection to operators is necessary. (" Machine Design," 1948/July/101.)

Synthetic hose based on Buna and Neoprene, produced by Ronaflex Tubing Co., Inc., Packard Bdg., Philadelphia, 2, is claimed to be of increased life and dependability. Tubing of ¼-in. internal diameter will stand a bursting pressure up to 1,000 lb./sq. in. (" Materials and Methods," 1948/May/121.)

Plastic chairs, mass-produced from steel moulds, by General American, 135, S. La Salle Str., Chicago, 90, consist of a one-piece back and seat, four bolts, four legs, of either steel or aluminium. (" Business Week," 1948/July 24/54.)

Offset printing.—In a research report, Ch. G. Weber, M. B. Shaw, Martin J. O'Leary and J. K. Missiner describe a series of experiments with offset papers in which strength and resistance to surface pick were developed mainly by bonding the fibres with a synthetic resin instead of by heating. (" J. Res. Nat. Bur. Standards," 1948/June/427.)

Adhesives for polystyrene.—A number of advantages are claimed for a new adhesive (Koppers Co. Inc., Pittsburgh, Pen.), itself a polystyrene solvent, the solvent powers of which are controlled. Bonds between polystyrene and other materials, such as paper, cardboard, fabric, glass, rubber, and certain other plastics, are possible. (" Chemical Age," 1948/**59**/218.)

Hot-plate press.—A new 30-ton unit is said to be particularly suited for laminating, moulding, and also for forming powdered metals. The platens are electrically heated, and thermostatically controlled; the hydraulic system is totally enclosed. The makers are N.N. Machine Tool Works, Inc., 128, Orono Street, Clifton, N.J. (" Materials and Methods," 1948/**27**/126.)

Plasticizers.—In his investigations on plasticization, J. K. Craver concludes that a plasticizer operates by modifying the van der Waals forces within the resin. Some preliminary estimates of plasticizer compatibility and efficiency can be obtained by a study of chemical structure, molecular weight and related properties. (A.S.T.M. Bulletin, 1948/May/90.)

Vinylidene polymers.—K. Stoeckhert summarizes the production and applications of vinylidene chloride polymerizates. He refers to extrusion moulding, die-casting and manufacture of foils. (" Kunststoffe," 1948/Feb./31.)

Fishing nets.—A. von Brandt gives a short survey of plastics for use in the fishing industry. He compares the properties of fishing nets of synthetic fibre materials with those made of natural fibre materials. The use of plastic swimmers and plastics for the impregnation of net materials is also considered. (" Kunststoffe," 1948/Feb./36.)

Artificial sponge.—R. Vieweg reports investigations on artificial sponge materials. The pores contained in these materials require special mechanical and electrical methods for measuring their properties. The question whether there are open or closed pores, as well as size and distribution, appears to be difficult to answer. (" Kunststoffe," 1948/Mar./45.)

Injection moulding.—A double injection moulding process, by Gib Moulding Corporation, Chicago, Ill., provides for the moulding of plastic parts in two colours. Plastic of one colour is injected into one mould for the insert or basic part. After cooling this is removed, degated and transferred to a second mould, where plastic of another colour is injected. (" Machinery," N.Y., 1948/June/176.)

Anti-static properties.—A special synthetic wax (Glyco Products Co. Inc., Brooklyn, N.Y.) incorporated into moulding compounds is said to give excellent anti-static properties to the finished surfaces. (" Machinery," N.Y., 1948/July/189.)

Wood-metal bonding.—The importance of the wood-to-metal bonding process for the production of kitchen goods is stressed in an illustrated article by F. A. Westbrook. (" Machinery Lloyd " (Continental Edit.), 1948/**20**/64.)

High-temperature rubber.—The mechanical and chemical properties of the new high-temperature rubber on the basis of polyacrylic ester is described in detail. ("Materials and Methods," 1948/June/72.)

Light structures.—F. Wehrse gives a survey of experiences which has been obtained in the design and application of plastics for light structural work, in particular in the construction of vehicle bodies. (" Kunststoffe," 1938/**38**/149.)

Soft polyvinyl chloride.—F. Kainer attempts to give a survey of the literature on plasticized p.v.c. The information provided, considering also the numerous patents in this field, appears useful for the selection of suitable plasticizers. (" Kunststoffe," 1948/**38**/163.)

Silicone products.—Silicone products of General Electric Co., Pittsburgh, Mass., are described in an illustrated brochure which deals with oils, greases, water repellents and rubbers, including charts and reference tables. (" Wire and Wire Products," 1948/Aug./722.)

Resin - bonded paper. — National Bureau of Standards has developed a method for making paper from deciduous woods, such as maple, beech, birch or poplar, by substituting synthetic resin (melamine-formaldehyde) bonds between the fibres in place of the gel-like bonds formed by hydration. (" Technical News Bulletin," 1948/Aug./94.)

Phenolics.—A new thermosetting cast phenolic for high-temperature applications (Catalin Corporation of America, 1, Park Avenue, New York, 16) is said to stand heat distortion up to 325 degrees F., coupled with high compressive and good impact strength. The surface hardness is 100 to 120 Rockwell H, and the material resists scratching and wear. Applications include handles and knobs on aluminium ware. (" Materials and Methods," 1948/July/106.)

Cigarette-proof plastic, " Satusply," has been developed by United States Rubber Co., based on war-time experiences. In its production paper or cloth is completely impregnated and surfaced with a polyester thermosetting resin. Colour and design possibilities are said to be almost unlimited. Degree of stiffness can be controlled during manufacture. A special cement is also produced to bond the material satisfactorily to the base surface. (" Automotive Industries," 1948/July **1**/54.)

SOURCES OF REFERENCE

We wish to remind readers that the sources of reference from which these pages are compiled are not, in general, retained in this office. We cannot, therefore, undertake to supply such originals. Nevertheless, most of the foreign journals referred to are available in the Patent Office Library (Southampton Buildings, Chancery Lane, W.C.2) and in the Science Library (South Kensington). Photo-duplicated copies of articles may be obtained from the Photostat Dept. of the Patent Office.

New Uses for Vinyl Plastics in the Shoe and Leather Industries

By John S. Trevor

SHOE manufacturers and tanners are showing considerable interest in the potentialities of plastics, particularly the vinyl polymers and co-polymers, for a number of applications, some of which are likely to consume substantial quantities of these materials.

Vinyl plastics are perhaps best known to the tanner as finishes for shoe uppers. Polyvinyl chloride and polyvinyl chloride-acetate are now being successfully applied to both chrome and semi-chrome tannings. These vinyl finishes give an improved appearance, good resistance to grease, abrasion and staining, and they are available in a wide range of colours with either fine gloss or dull finish. The latex, which is a water dispersion of finely divided vinyl resin, contains no plasticizer, and forms a continuous coherent film without fusing. Maximum properties of the film, such as high tensile strength, resistance to oil and abrasion, can be obtained by simply drying the film at any temperature up to 300 degrees F.

The usual method of applying the latex coating is with a swab or spray gun. The adherence, due to the tack of the resin particles and the degree of penetration into the leather, is increased if the surface is rough and unfinished. A synthetic rubber latex—e.g., "Hycar"—can be added to the vinyl latex—e.g., "Geon" Latex 31 X—to increase the tackiness and adhesion of the first coating to the leather, the final coating being pure vinyl latex.

Water-dispersible pigments and loading agents, such as titanium dioxide, basic lead carbonate, whiting and clay, can be added to the latex, the best procedure being to prepare stable emulsions of the additives by ball milling, and then to add to the latex with gentle agitation.

The shoe manufacturer is interested in similar types of dressings for the final finishing and touching-up of lasted shoes. A new kind of protective strip coat based on vinyl co-polymer has recently been introduced in shoe factories for the protection of white suede shoes during factory processing. The coating is sprayed on the shoes directly after lasting, so as to keep them clean and protect them when handled. The film dries in 15 to 20 secs., and may be peeled off the uppers in a few seconds.

New vinyl-coated fabrics are being used by shoe manufacturers for such purposes as lacings, linings and uppers. These materials are claimed to be porous, easy to sew or heat-seal, and they are available in a wide colour range. The fabrics can be woven, braided or crocheted, and so far they are mainly limited to glass yarns as the core, though multi-filaments, including nylon, rayon, cotton and silk will soon be used. The makers claim that the new fabrics neither stretch nor shrink, are impervious to many chemicals, and have an extremely high abrasion resistance. The film is applied to the core rather than spirally wound round it, this providing a more uniform weaving surface.

Vinyl plastics, in the form of sheeting, are being used in large quantities by the shoe and bag trades. This sheeting has been specially designed for extruding and calendering, and is well adapted to embossing and press-polishing operations. Preference is marked for the new colloidal blends of polyvinyl chloride and nitrile rubber polymers. By the use of these so-called poly-blends, problems of satisfactory adhesion can be completely over-

come. The new sheeting may be cemented permanently, because there is no evaporation or migration of plasticizers. Moreover, it can be cut and sewn, and may be nailed like leather, and worked on usual leather fabrication machinery.

Wrinkles can be ironed from the vinyl sheeting as simply as leather; other techniques for handling are practically identical with the working of leather. Shoe uppers made with vinyl co-polymers and vinyl resin blended with nitrile rubbers can be more flexible than the softest leather and more rigid than the heaviest, yet in all grades the makers claim that it is permanently scuffproof, resistant to ageing and cracking, and virtually unaffected by oil and grease.

Extruded vinyl plastic filaments or strands are now being used in combination with raffia, sisal and cotton for weaving shoe fabrics. The function of the plastic is to enable the fabric to retain the lasted shape only for a temporary period. The coarse strands of polyvinyl chloride are so placed as to lie in parallel relationship in the knitted web, and are kept in a fairly straight line. It is important that the plastic strands are "enmeshed" longitudinally around the entire upper, so that full conformation may be realised. Through the use of heat applied to the plastic strands the upper contracts to a tight fit to the wood of the last. After the upper has contracted to the conformation of the last, the plastic thickens and hardens into a tough and resilient condition.

A new and ingenious idea makes use of extruded vinyl strip as a plastic storm welt. This is designed with a special storm welt ridge that "snuggles" into the insole margin area and covers up "grinning" stitches. The main advantage of the vinyl plastic welting is the exactness of the groove, bevel, iron and storm shoulder.

Thermoplastic adhesives based on vinyl chloride-acetate polymers, vinylidene chloride-vinyl chloride co-polymers, as well as blends of polyvinyl chloride and nitrile rubbers, are of great importance, particularly for the "stuck-on" shoe process. The newer cements give joints that are hard and non-tacky, thus permitting ease and facility in placing in position the shoe parts in the machine, before the fluid type of pressure is applied to unite the parts. Special all-purpose cements for use with leather, rubber and plastics are also based on vinyl polymers. These adhesives are cold-setting, require only a one-surface application, and possess good wet "grab," moreover the bond itself remains permanently flexible and will not become brittle.

Moulded Electrical Insulations

A series of British Standards dealing with the performance of moulded materials used for electrical insulation is approaching completion. The first of these specifications, B.S.488, first published in 1933, has been revised and is now available as B.S.488 (1948), "Moulded insulating materials for general electric purposes." This series of standards approaches the problems of specifying electrical insulating material from the point of view of the designer of electrical equipment, who requires certain properties to meet given conditions of use, but desires also a free choice among the various materials that might meet these needs. Each of the specifications in the series is therefore designed to include all the types of materials that meet the requirements of the branch of electrical work covered by the specification, and the whole series provides similar methods of test for all types of materials where this is possible, to permit comparison of technical data.

The revision of B.S.488 covers moulded materials (excluding ceramics) for use as insulating materials for general electric purposes on currents up to 250 volts, and at working temperatures not exceeding 100 degrees C. The standard provides for four grades of moulded materials based on resistance to heat and specifying qualifying limits for electrical properties, resistance to heat, strength and general properties for each grade. Copies may be obtained from the British Standards Institution, Sales Department, 24, Victoria Street, London, S.W.1, price 2s. 6d. post free.

Welding P.V.C. Linings for Steel Barrels

A DIFFICULT job in the welding of p.v.c. was recently brought before the Radio Frequency Heating Division of Pye, Ltd., Cambridge. They were approached by Tanks and Linings, Ltd., of Droitwich, to know if they could supply the necessary R.F. generator and jigs to make removable p.v.c. linings for steel barrels, thus making these barrels suitable for the carriage of liquids which would otherwise attack the steel. The lining comprised a tube with two ends welded on, in one of which a small tube was fixed to act as the filler.

Four problems were involved: (a) The making of the tube, which necessitated straight welds of up to 36 ins. with 14 thou. p.v.c.; (b) welding the ends of the same material on the tubes, which were either 14-in. or 22-in. diameter; (c) the strength of the welds had to be such that on inflating the linings under pressure the material would tear before the weld opened; and (d) the p.v.c. was a non-toxic, non-smelling variety, which did not weld as easily as most other grades, due to the plasticizer that had to be used.

The first jig to be constructed was the one for making the tubes, the length of the straight weld being up to 36 ins. Here it was found that considerable pressure was required and that the spacing between the two electrodes had to be maintained within one-half thou. when hot or cold, so that consistent results were obtainable. This necessitated making the structure extremely rigid and using materials of similar coefficients of expansion.

The final jig had an adjustable pivot at one end, together with a counter-balance weight so placed that in the free

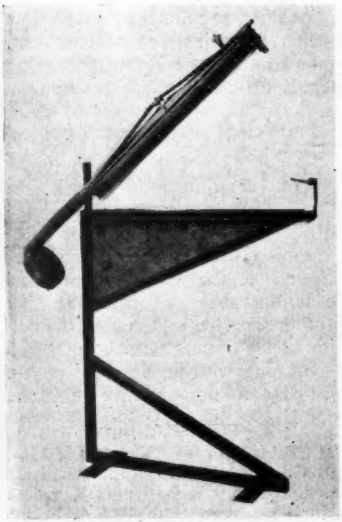


Fig. 1 (above).—Jig for straight line weld, 36 ins. in length.

Fig. 2 (right).—Jig for 22-in. diameter circular weld.

position the angle between the electrodes was about 40 degrees. The other end was held down under spring tension on an adjustable stop, to enable the material thickness to be varied. Normal safety precautions were taken, so that the electrodes could not be touched when closed and power could not be switched on till the jig was loaded.

The circular jig presented its own problems, the first being that the electrode could not be inside the tube on both welds, so it was decided that no advantage would be gained by having lap and butt joints, compared with two butts. It was decided the only solution lay in making one electrode of the required inside diameter and allowing the tube to be dropped into this. The upper end of the tube was stretched and folded over the electrode, so holding itself in place and avoiding creases which would occur if the material was turned inwards. The end was then stretched between this p.v.c.-covered electrode and the upper electrode, which was pivoted and counterbalanced as the straight one, and brought down and clamped on to its stops in four places on the 14-in. and six on the 22-in. diameter jig. The accuracy of the spacing was even more exacting than on the 36-in. weld.

Having fixed the first end in position, the tube was then inverted for the application of the second one, which had previously had the filling neck welded to the flat top.

The required widths of the welds were to be 13-ins., giving weld areas of $4\frac{1}{2}$, $5\frac{1}{2}$ and $8\frac{3}{4}$ sq. ins. on the straight 36-in., 14-in. diam. and 22-in. diam. jigs respectively; the welding times were 15, 15 and 30 seconds respectively. The R.F. generator employed was the standard 3-kW type 3/10, as made by Pye, Ltd., but slightly modified to work with jigs of greater electrical capacitance than normally encountered.

If a better welding quality of p.v.c. were used the welding times could be reduced considerably, but the overall time is really determined by the speed of loading. Using one jig the generator is idle for approximately three-quarters of the time, giving an overall efficiency of only 25 per cent. By employing two jigs and a special change-over switch, it can be arranged that one jig is being loaded whilst the other is welding, so reducing the idle time of the generator to just under 50 per cent.

Certain details of these p.v.c. linings, as also details of the jigs, are covered by patents.

APPLICATIONS OF ACRYLIC PLASTICS IN LIGHTING

(Continued from page 517.)

The collection of dust due to static charge, and the danger of surface abrasion by wind-borne dust or by cleaning, are two possible faults of acrylic materials that can be avoided by reasonable care. The retention of static charge is due primarily to the high surface resistivity of acrylic sheet. To enable surface leakage to take place, the material is treated with a wetting agent in the form of a paste. This paste is applied thinly over the surface of the shaping, which is then lightly polished to remove any excess. The treatment lasts for a time depending on the vigour and frequency of polishing and on the atmospheric conditions in which the fitting operates. When fittings are used outdoors or in very dirty indoor locations, cleaning with soap and water has been found to be the best practice. Should serious abrasion occur, the high polish of the surface of the material can be restored by buffing with a soft mop or by polishing with an abrasive polish, followed by a non-abrasive finishing compound.

FURFURAL.—As from October 1, 1948, Imperial Chemical Industries, Ltd., will act as sole selling agents in the United Kingdom for furfural produced in the U.S.A. by the Quaker Oats Co., of Chicago. From that date all inquiries are to be addressed to I.C.I.'s Sales Offices, which will also give assistance in all matters concerned with the use of furfural.

Silicon Modified Plastics

By H. G. Emblem, C. Marsden and G. E. Stockwell

THE past few years have been notable for the marked industrial interest shown in the group of polymers known as "silicones." These polymers are organo-silicon compounds and have a remarkable range of physical properties coupled with chemical stability.

The relatively high prices of silicones, and the present import restrictions, limit their application to highly technical problems in which unusual working conditions prevail. Nevertheless, silicones are being used to improve the technical characteristics of certain more commonplace materials. For example, alkyd resins blended with silicones have been proposed as high-temperature coatings.[1]

By blending normal plastics with other more readily available silicon compounds, such as ethyl silicate or silicon tetrachloride, materials having improved working characteristics may also be produced. This, therefore, is a method by which an alternative approach can be made to some of the specialized properties of the silicones.

Plastics, in general, may be modified with silicon either by bringing about a chemical reaction with a suitable silicon compound or by direct mixing with finely divided silica. The former process is the more important, and it is the purpose of this article to survey the chemistry of the reactions involved. Indications are given of some of the applications of the resulting modified materials. So far the only cases where mixing with finely divided silica gives results of any industrial significance are with polyvinyl chloride and natural rubber.[2, 3]

The chemical reactions involved in the modification of plastics with silicon are conveniently divided into three groups: (a) Direct esterifications; (b) ester interchanges, and (c) copolymerizations, involving suitable organo-silicon monomers.

Direct Esterifications

The direct esterifications are developed from the reaction between hydroxylic compounds and a silicon halide, normally silicon tetrachloride or an organo-substituted silicon chloride. Obviously, these reactions are applicable to any plastic or plastic intermediate which contains hydroxyl groups. Phenolic resins are especially suitable for modification in this manner. According to Nason[4] the reaction taking place may be represented as,

$$4ROH + SiCl_4 \longrightarrow Si(OR)_4 + 4HCl$$

or more generally as,

$$a(R-OH) + SiX_a R^1_{(4-a)} \longrightarrow (R-O)_a SiR^1_{(4-a)} + a(HX)$$

Here "R" denotes the phenolic resin complex, whose terminal grouping is OH; "X" represents a halogen; "R^1" an organic substituent in the silicon tetrahalide; and "a" the number of halogen atoms present. Usually silicon fluorides react anomalously; this is in accordance with the general chemistry of organo-silicon fluorides.

The characteristics of the products of these esterifications can be altered to cover a wide range. The variable factors are:—

(1) Type of resin used.

(2) Reaction conditions.

(3) Substituent groups in the silicon tetrahalide.

(4) Reactive modifying agent, such as drying, semi-drying or non-drying oils.

(5) Non-reactive modifying agents, for example, plasticizers, such as dibutyl phthalate.

By judicious selection of raw materials and careful control of reaction conditions, the final product can be made to be compatible with most natural and syn-

thetic resins, cellulose derivatives, drying oils, chlorinated rubber, and the usual plasticizers.

Ester Interchanges

Methods for the modification of plastics are derived from the re-distribution reactions which take place when a silicon ester is refluxed with another ester, or hydroxylic compound, a statistical re-distribution of organic groupings being the result[5]. In the final stages the reaction is represented as:

$$Si(OR)_4 + 4rOH \rightleftharpoons Si(Or)_4 + 4ROH$$

The ester interchange reaction, therefore, provides an alternative to the use of silicon halides for the modification of hydroxylated plastics or intermediates. It is to be preferred because more reproducible results are obtained and the presence of halide acids is eliminated. Traces of the latter could greatly accelerate failures in electrical mouldings.

Both the esterifications and the ester interchanges described above have the drawback that they are reactions between compounds of multiple functionality. The products are, consequently, highly cross linked and, because of this, they are inflexible. This inflexibility is effectively minimized by reducing the functionality of the reacting molecules. This usually involves the prior conversion of some of the reactive silicon groupings to the non-reactive silicon–carbon linkage and may be compared with normal "end-stopping" methods.

Copolymerization of Suitable Organo-Silicon Monomers

The methods of copolymerizing more than one ethylenically unsaturated monomer are, of course, well known. These principles may be used to produce silicon modified polymers by copolymerization involving organo-silicon compounds. The latter must also contain at least one ethylenically unsaturated grouping. For example, tetra allyl silicate, $Si(O-CH_2-CH=CH_2)_4$, may be copolymerized with methyl methacrylate. Benzoyl peroxide is normally used as the polymerization catalyst. The resulting product is tougher than normal polymethyl methacrylate[6]. Similarly, styrene and butadiene may be copolymerized with tetra allyl silicate or tetra furfuryl silicate[7].

Ethyl Silicate as a Modifier

There is some evidence to indicate that a partial interchange reaction takes place between ethyl silicate and wood cellulose. This fact is utilized by first impregnating wood flour, or sawdust, with refluxed ethyl silicate, and then impregnating again with a phenolic resin. The composition thus produced can be subsequently moulded, when the heat and pressure involved bring about the interchange reaction described above. The rate and extent of the curing of a composition of this type is accelerated by extreme acidity or alkalinity, i.e., conditions outside the pH range 4-9.

Unless the ethyl silicate is refluxed, inconsistent results will be obtained. Commercial ethyl silicate is a mixture of ethyl orthosilicate and varying amounts of ethyl polysilicates. Refluxing this mixture narrows the range of polysilicates, leading to more consistent results. Refluxed ethyl silicate, which contains 40 per cent. (w/w) of silica, is soluble in most organic solvents. It is moisture sensitive, but not directly water miscible, and is, therefore, completely stable if kept in an air-tight container.

The modification of phenolic-type thermosetting resins and moulding powders with refluxed ethyl silicate has been found to serve a dual purpose. Economies in the phenolic resins result, with improved working characteristics.

In practice 15 per cent. of the total phenolic resin normally used to prepare a moulding composition with a wood flour or sawdust filler may be replaced by 5 per cent. of refluxed ethyl silicate. On comparison with a normal resin moulding, the silicon modified moulding was found to show improved fire, chemical, and weathering properties. Electrical tests indicated that the presence of silica gave improved anti-tracking properties.

The moulding conditions for the modified composition allow a certain flexibility in the choice of temperatures and pressures. These can be between 150 degrees and 160 degrees C., with a minimum of 100 degrees C., and between 1,200-3,500 lb. per sq. in. Increased filler particle size reduces the amount of refluxed ethyl silicate required. Coloured mouldings are prepared from dyed materials.

In the case of cellulosics, modification with ethyl silicate improves the pliability and tear strength of films.[8] Ethyl silicate cellulose nitrate lacquers, form films possessing a much improved adhesion to glass, when compared with unmodified films.

Uses of Silicon Modified Resins

It has been indicated that silicon modification results in increased strength, fire, chemical and weather resistance. Where these properties are required in a finished article, then a silicon modified resin can probably be used to obtain them without drastically changing the moulding technique usual for such articles.

However, the greatest number of applications of silicon modified resins and plastics are as paints and coatings of unusual durability. These finishes are valuable for the treatment of places and structures exposed to severe chemical attack, for example, water, and chemical storage tanks, or installations affected by sea water. Improvements in coating compositions utilizing organo-silicon compounds are constantly being evolved, and a number of patent specifications covering various techniques have already appeared. These have been summarized and discussed elsewhere.[9]

At the present time the silicones, with their highly specialized properties, would appear to hold the major commercial interest. However, applications arise in all industries for which the conventional plastics are only just inadequate, and which do not require all of the silicone properties. It is considered that in these applications the reaction of normal plastics with the readily available and relatively cheap silicon compounds, offers the technologist an alternative solution to the use of silicones in his own specific industrial problem.

REFERENCES

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CELLULOSE ACETATE PLASTICS

(Continued from page 535.)

of creep and an intermediate transition period. Under high load only, is the first stage observed, and fracture takes place quickly. Under small loads, the rate of creep is very small, and the second stage is not normally observed. At intermediate stresses, however, the rapid first stage of creep, the transition stage and the slow second stage of creep are all observed.

Findley concluded from his work that the relationship between stress and strain, and the rate of creep in the first stage, could be expressed mathematically by an equation $s = mr^n$, where s is the stress, r is the rate of creep, and m and n are constants, depending on the material and the conditions of the test. The application of this law is illustrated in Fig. 15, which shows the relation between stress and rate of creep when both variables are plotted on log scales. The diagram also illustrates that ageing affects only the constant m, and not the constant n, the latter being represented by the slope of the line.

(To be continued.)

Plastics in Germany.—The unsatisfactory state of the supply of raw materials for the plastics industry in the West Zones of Germany during the past year is stressed in a report published in "Kunststoffe" (1948/Aug./159).

Cellulose Acetate Plastics

XVI.—Mechanical Properties of Cellulose Acetate

By
Vivian Stannett
and R. Whitfield

CELLULOSE ACETATE plastics are noted for their versatility and variety of application, but it is not always appreciated that this is due largely to the wide variations in mechanical properties, which are made possible by suitable modifications in formulation. As with all plastics, an accurate knowledge of these properties is essential if the material is to be used to its best advantage.

The large number of mechanical properties which are often quoted for a plastic may appear confusing, but it is important to recognize that a balanced set of mechanical properties is, in general, of greater importance than any one good individual property. For example, a product which has an excellent impact strength may be quite unsatisfactory for a given purpose, owing to the fact that its compressive strength is too low. For different methods of fabrication of cellulose acetate, the importance of different mechanical properties varies. Thus, in the case of moulded material and thick sheets, impact strength is usually of great importance, where as in the case of films, tensile and tearing strengths become more important. The prime consideration is, of course, the ability of the material to withstand the mechanical stresses to which it is likely to be subjected under practical conditions of service, and as these may include wide variations in temperature, humidity, etc., a knowledge of the effects of these factors on the mechanical properties is of great importance.

Before considering in detail the mechanical properties of cellulose acetate plastic compositions it will be of interest to compare, in general terms, some of the properties of this plastic with those of other well-known materials. It will be appreciated that only a very rough comparison is possible, as cellulose acetate plastics themselves show wide divergencies of properties.

The impact strength of cellulose acetate is very good, and in this respect the material is superior to either polymethyl methacrylate or polystyrene, but inferior to plastics of the laminated phenolic type. The ultimate tensile strength of cellulose acetate compares favourably with polystyrene, but is rather lower than that of polymethyl methacrylate. The tensile strength of laminated phenolics is, however, much higher than that of cellulose acetate. It is hardly valid to compare the elongation under tension of thermoplastic materials, as this property can usually be varied between wide limits by suitable modifications in the formulation, but, in general, the

Table I.—Plasticizers tested with Cellulose Acetate.* [Gloor (3).]

(Cellulose acetate of 53.0% combined acetic acid content, 50 seconds viscosity fall time of $\frac{1}{16}$ in. steel ball through 10 inches of a 20% solution of 9 acetone: 1 alcohol, in vertical 1 inch tube at 25°C.)

Plasticizer	Percentage plasticizer in plastic†	Charpy impact at −20°F ft. lb./in. notch
Diethylene glycol dipropionate ‡	23.5	0.57
Diethyl phthalate	31	0.50
Dimethyl phthalate	31.5	0.37
Tripropionin	33	0.35
Triacetin	27	0.32
Triethyl citrate	30	0.26
Dibutyl tartrate	30	0.23
Methyl phthalyl ethyl glycollate §	31	0.15

* Amount in plastic=100% plasticizer.
† To give Rockwell (M) hardness of 45 at 70°F and 50% R.H.
‡ K-P. 45 (Ohio-Apex, Inc.)
§ Santicizer M-17 (Mohsanto)

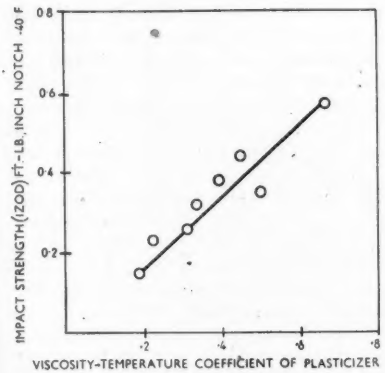

Fig. 1.—Relationship between viscosity-temperature coefficient of plasticizers and sub-zero impact strength of formulation. (Gloor.[3])

elongation of cellulose acetate at breaking point is greater than that of either polystyrene or polymethyl methacrylate.

The compressive strength of cellulose acetate is rather low; it compares unfavourably with that of thermoplastics, such as polystyrene and polymethyl methacrylate, and most unfavourably with thermosetting resins of the phenolic type. The shear strength calls for no special comment, but in common with other thermoplastic materials it is much lower for cellulose acetate than for thermosetting plastics. For extensive data on the mechanical properties of various plastics reference may be made to the work of Oberg, Schwartz and Shinn.[1]

Impact Strength

As high resistance to impact is one of the outstanding properties of cellulose acetate, this will be considered first. The large quantities of cellulose acetate which are used for the manufacture of virtually unbreakable injection-moulded products emphasizes the great importance of this property. Finished products, such as children's toys, combs, spectacle frames, etc., all require to be manufactured from material of high impact strength if they are to withstand normal usage. It is not surprising, therefore, to find that considerable emphasis is placed on high impact strength by commercial moulders.

Although it is not intended at this stage to discuss in detail the various methods by which impact strengths are determined, brief reference will be made to the two methods most commonly used in connection with plastics, as the results obtained differ according to the instrument and method employed. In the Charpy method a standard test piece is freely suspended at both ends and is struck in the centre by a weighted pendulum. In the Izod method a standard test piece is supported rigidly at one end only and is struck at the other end by a weighted pendulum. In either method, notched or un-notched test pieces may be used, but the results so obtained do not bear any direct relation to one another.

The impact strength of moulded cellulose acetate is influenced to a great extent by the nature and quantity of the plasticizers used in the formulation. In general, an increase in plasticizer content results in an increase in the impact strength, but as a too high concentration of plasticizer leads to the formation of over-soft products, a compromise has always to be made.

The variation of impact strength with

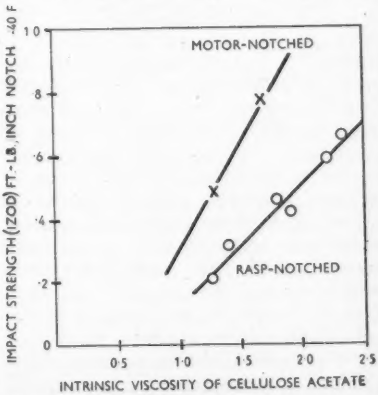

Fig. 2.—Relation between intrinsic viscosity of cellulose acetate and sub-zero impact of plastics. (Gloor.[3])

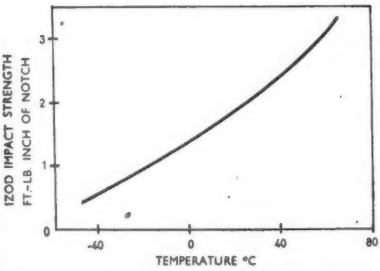

Fig. 3.—Effect of increased temperature on impact strength.

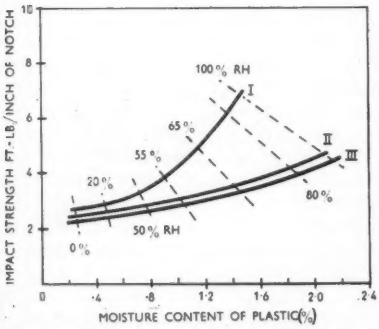

Fig. 3a.—Effect of moisture on Izod impact strength of cellulose acetate at 77° F. (Carswell and Nason[5].)

I—"ES" flow, 37.5 per cent. plasticizer.
II—"MS" flow, 33.3 per cent. plasticizer.
III—"H" flow, 29.6 per cent. plasticizer.

temperature is very important, and since many cellulose acetate mouldings, such as those required for aeroplane fittings, must be able to withstand very low temperatures, this aspect has been closely studied, notably by Gloor.[3, 10]

Gloor prepared a number of cellulose acetate formations containing different plasticizers and adjusted the amounts present in such a way that all the specimens had the same hardness. The impact strengths were then determined at −20 degrees F. by the Charpy method, and the results as shown in Table 1 were obtained. Examination of these results shows that the formulation containing diethylene-glycol dipropionate had the best sub-zero impact strength, but diethyl phthalate is almost as efficient, and is also a valuable plasticizer on account of its permanence and general utility. The decidedly lower value obtained with diethyl phthalate is also worth noting.

In the same work Gloor showed that a relation exists between the sub-zero impact strength of cellulose acetate and the viscosity-temperature coefficient (i.e., the slope of the viscosity-temperature curve) of the plasticizer (Fig. 1), and suggests that this offers an indirect method of evaluating plasticizers for low-temperature purposes. The value of this method over the more conventional direct-impact trials is, however, very doubtful, although it would probably serve as a useful guide in the selection of suitable plasticizers. Examination of the variation of sub-zero impact strength with the degree of acetylation of the raw flake showed that there was little variation over the range examined. On the other hand, the intrinsic viscosity of the cellulose acetate flake was shown by Gloor to be an important factor, as seen in Fig. 2, taken from the same paper. It was shown that, by raising the intrinsic viscosity of the flake used in compounding from the usual values of 1.2 to 1.4 to a value approaching 2, the impact strength at −40 degrees F. could be improved by at least 50 per cent.

Increase in the viscosity of the cellulose acetate used is found also to lead to an improved impact strength at normal temperatures, but reaching a

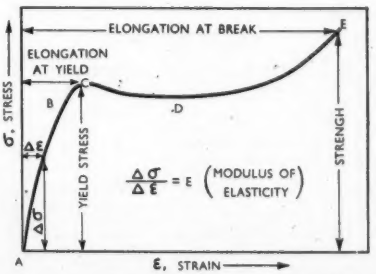

Fig. 4.—General form of stress-strain curve for plastic material (after Carswell and Nason).

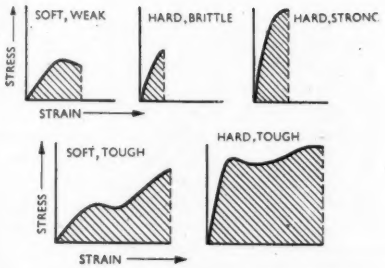

Fig. 5.—Stress-strain curves for different types of material.

steady value of a particular viscosity beyond which point no further improvement takes place with increase in viscosity. This effect, and also the effect of changing the acetyl value on impact strength at normal temperatures, were shown graphically in a previous article in this series.[4] Increase in the temperature is found to give increased resistance to impact; this tendency is shown graphically in Fig. 3. In this connection it is worth noting that polystyrene and polymethyl methacrylate both show a very slight decrease in impact strength as the temperature is increased.

The effects of humidity on impact strength have also been investigated, notably by Carswell and Nason,[5] and the results (Fig. 3A) show that the impact strength increases with the moisture content of the plastic, corresponding to increase in the humidity. The curves also indicate that this increase is more marked with highly plasticized formulations. This increase is generally attributed to the plasticizing action of the absorbed moisture and a similar conclusion is reached by examination of the effects of humidity on other mechanical properties of cellulose acetate.

Tensile Properties

Mouldings and films made from cellulose acetate are often required to withstand stretching forces and consequently a knowledge of the behaviour of the material under tension is of importance. Information concerning tensile properties

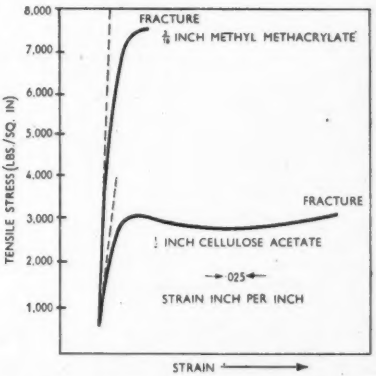

Fig. 6.—Tensile stress-strain properties of cellulose acetate and polymethyl methacrylate sheet (Oberg, Schwartz and Shinn[1]).

is also particularly useful, as it gives some indication of the toughness or brittleness of the material.

The general type of stress/strain curve which is obtained when a test piece of cellulose acetate is stretched at a constant rate is illustrated in Fig. 4. As will be seen, up to a certain point (B), the stress/strain graph is a straight line, indicating that the stress is directly proportional to the strain. This is the region (A-B) in which the plastic exhibits elastic behaviour and Hook's Law is obeyed. If the stress is released before point B is reached, the plastic will return almost completely to its original shape. Above point B the graph is no longer a straight line and the plastic begins to yield permanently to the stress. The yield stress is indicated by point C on the graph. From C to D there is usually a dip in the curve, indicating that the tension has been eased by the plastic or visco-elastic flow which has taken place in the material. Further straining results in a slow increase in the tensile stress until finally the material breaks (F). The tensile strength at break, often called the ultimate strength, is an important property of the material.

A considerable amount of information may be obtained from stress/strain curves

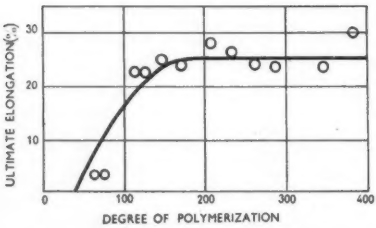

Fig. 7.—Ultimate elongation of cellulose acetate as function of polymerization degree (after Sookne and Harris [8]).

such as the one shown in Fig. 4. The slope $\frac{\Delta\sigma}{\Delta\epsilon}$ of the straight line portion AB gives the modulus of elasticity of the material, and the horizontal distances to points C and E give the elongation at yield and break respectively. The region BCDE indicates the conditions under which plastic deformation takes place and the area under the whole curve represents the work expended on the plastic during stretching and consequently is a measure of the toughness of the material.

The interpretation of characteristic stress/strain curves is illustrated in Fig. 5, and actual curves obtained by Oberg, Schwartz and Shinn for cellulose acetate and polymethyl methacrylate are shown in Fig. 6. The latter illustrate clearly the relative toughness of cellulose acetate and the hard but brittle nature of polymethyl methacrylate.

The tensile properties obtained from a single stress/strain curve refer only to the particular set of conditions prevailing during the test, and in practice these properties are influenced by a number of factors, the most important of which are:—

(1) Nature of cellulose acetate flake.

(2) Nature and quantity of plasticizer used in the formulation.

(3) Environment conditions such as temperature and humidity.

(4) Mechanical conditions of test, e.g., rate of straining of test piece.

As with all high polymers, the tensile strength of cellulose acetate varies with

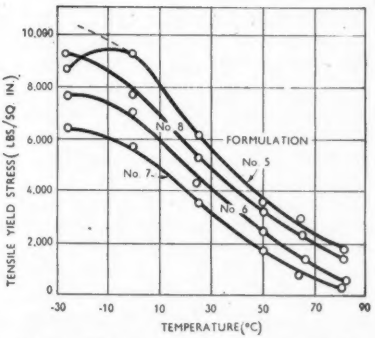

Fig. 8.—Effect of temperature on tensile yield stress of injection moulded cellulose acetate (medium acetyl formulation). (Welch, Hayes, Carswell and Nason [7]).

Formulation No. 5 .. 25 per cent. plasticizer
Formulation No. 6 .. 30.9 per cent. plasticizer.
Formulation No. 7 .. 35.6 per cent. plasticizer.
Formulation No. 8 .. 27 per cent. plasticizer.

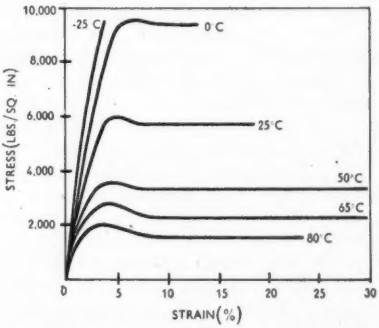

Fig. 9.—Typical stress-strain curves for injection moulded cellulose acetate [7] (formulation No. 1, A.S.T.M. type II, grade 7).

the degree of polymerization and also with the molecular weight distribution of the raw flake. In general, tensile properties are found to improve as the degree of polymerization increases, but when a certain stage is reached, further increase in the degree of polymerization does not appreciably improve the tensile properties. This is illustrated in Fig. 7, which shows how the ultimate elongation of cellulose acetate varies with the degree of polymerization. The effects of variations in the molecular weight distribution are, however, less thoroughly understood,

although the work of Sookne and Harris[9] on the mechanical properties of cellulose acetate films made from blends of fractions of varying degrees of polymerization clearly shows that low molecular weight material has a harmful effect on tensile properties.

The nature and quantity of the plasticizers used exert an important influence on tensile properties and, as would be expected, increase in plasticizer content is accompanied by a decrease in the tensile yield stress and by an increase in the ultimate elongation. Investigations by Welch, Hayes, Carswell and Nason[7] showed that although changes in plasticizer content alter the tensile strength values, the general shape of the yield stress/temperature curve (Fig. 8) is not appreciably affected.

Temperature and Tensile Properties

The effect of temperature changes on cellulose acetate is illustrated by the series of stress/strain curves shown in Fig. 9. At low temperatures the material has a high ultimate strength, but the elongation at break is small. The material is, in fact, relatively hard and brittle. At higher temperatures the ultimate elongation increases and the material becomes tough, but the ultimate strength is reduced somewhat. With further increase in temperature the tensile strength is considerably

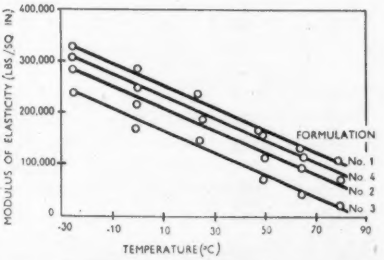

Fig. 10.—Effect of temperature on modulus of elasticity of injection moulded cellulose acetate (medium acetyl). (After Welch, Hayes, Carswell and Nason[7].)

Formulation No. 1 .. 28.6 per cent. plasticizer.
Formulation No. 2 .. 32.3 per cent. plasticizer.
Formulation No. 3 .. 37.2 per cent. plasticizer.
Formulation No. 4 .. 28.4 per cent. plasticizer.

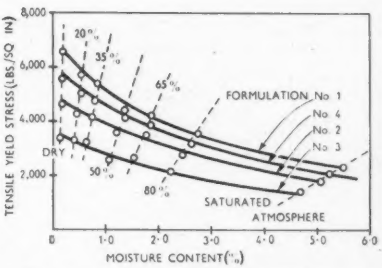

Fig. 11.—Effect of relative humidity on tensile yield stress of injection moulded cellulose acetate (medium acetyl)[7].

Formulation No. 1 .. 28.6 per cent. plasticizer.
Formulation No. 2 .. 32.3 per cent. plasticizer.
Formulation No. 3 .. 37.2 per cent. plasticizer.
Formulation No. 4 .. 28.4 per cent. plasticizer.

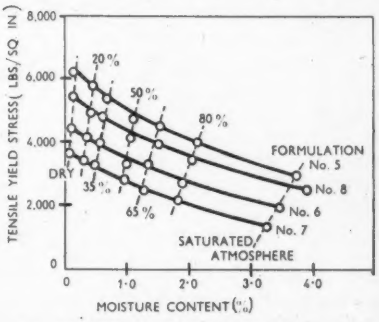

Fig. 12.—Effect of relative humidity on tensile yield stress of injection moulded cellulose acetate (high acetyl)[7].

Formulation No. 5 .. 25 per cent. plasticizer.
Formulation No. 6 .. 30.9 per cent. plasticizer.
Formulation No. 7 .. 35.6 per cent. plasticizer.
Formulation No. 8 .. 27 per cent. plasticizer.

reduced and the material becomes soft and weak. Experiments by Welch, Hayes, Carswell and Nason on the effect of temperature changes on the ultimate elongation of cellulose acetate under tension showed that an increase is observed up to approximately 50 degrees C., but at higher temperatures a decrease takes place. It follows from this that there is a certain temperature at which the elongation is at a maximum, but in practice this temperature depends on a number of variable factors, such as the nature of the cellulose acetate flake and the plasticizers used in the formulation.

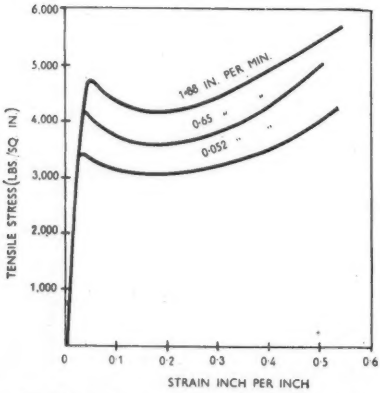

Fig. 13.—Influence of rate of straining of test-piece on stress-strain curve (Findley[8]).

Tests by the same authors on the influence of temperature changes on the modulus of elasticity of cellulose acetate formulations showed that over a certain range the modulus was directly proportional to the temperature. Hence the modulus/temperature graph is a straight line (Fig. 10), and further experiments revealed that variation in plasticizer content did not appreciably alter the slope, but merely the position of the line relative to the origin.

Humidity and Tensile Properties

Humidity also affects the tensile properties, and the general effect of this factor is shown in Figs. 11 and 12, which illustrate the variation of tensile yield stress for materials of high and medium acetyl values respectively. It will be seen that as the moisture content increases, corresponding to increase in humidity, the tensile yield strength decreases; but as saturation point is reached, changes take place more slowly. The influence of

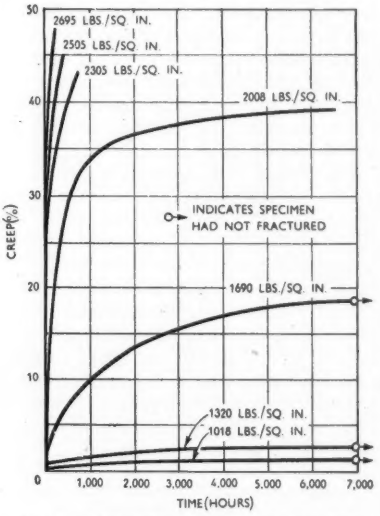

Fig. 14.—Creep-time diagrams for cellulose acetate at 77 ± 1° F and 50 ± 2 per cent R.H. (Findley[13]).

humidity on mouldings made from high acetyl material is less than in the case of medium acetyl mouldings, mainly on account of the superior water resistance of the former. As has already been mentioned, moisture acts in many ways as a plasticizer with cellulose acetate formulations. However, under highly humid conditions corresponding to high moisture contents, a relative reduction in percentage elongation takes place, the effect being more pronounced in the case of highly plasticized formulations.

The modulus of elasticity is adversely affected by highly humid conditions. The decrease in the modulus is rapid at first, but slows down as the saturation point is reached.

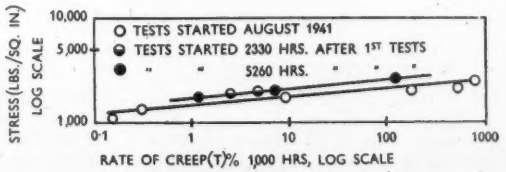

Fig. 15.—Effect of stress on rate of creep, log scale. (Findley[13]).

Mechanical Conditions

Although the effects of rate of straining of the test piece could more appropriately be described under methods of test, it will be of interest to mention it here, as it illustrates very clearly that the results obtained from mechanical tests are only strictly valid under the precise conditions of the test, and may not bear any direct relation to service conditions, although, of course, the information obtained is usually a reliable guide, and, in any case, affords valuable comparative data between different plastics or between different batches of the same material. Fig. 13, taken from investigations by Findley,[8] shows stress/strain curves for the same plastic tested at different crosshead speeds (i.e., at different rates of straining). The highest yield stress is recorded with the highest crosshead speed, and this is due to the short time interval which prevents time effects, such as plastic flow, from exerting any appreciable influence. At lower rates of straining, creep effects are apparent, and are reflected in lower yield stress values.

Creep

The mode of fracture of cellulose acetate under tension may be briefly described. This subject has been studied by Findley, who points out that plastics differ from metals in that they exhibit both brittle and ductile properties. The large percentage elongation indicates ductility, but unlike metals, this is not the result of sliding along planes of maximum shearing stress. Plastics also differ from metals in that there is no marked necking and the reduction in area is uniform. The fracture obtained is usually characteristic of that of brittle materials and, as a rule, starts as a tear from some slight surface imperfection which spreads until rupture takes place.

The tensile properties which have so far been considered have all referred to the behaviour of the material under conditions of constant rate of straining, i.e., when stretched at a constant rate. In actual practice, mouldings are rarely subjected to such treatment and it is much more common to find that they are required to withstand constant loads for prolonged periods. All materials when subjected to a constant tensile force tend to extend, and the gradual increase in length with time is referred to as creep.

The subject of creep has received considerable attention both from a theoretical and practical standpoint. An excellent discussion on the theoretical aspects has recently been published by Adams and Throdahl[11], and W. N. Findley[12] has investigated the practical creep properties of cellulose-acetate plastics.

Findley's work showed that cellulose acetate mouldings undergo considerable periods of time. Fracture may also take place if the load is maintained for a sufficient length of time, even though the stress is far below the ultimate strength as determined by short time tests. Actual results obtained by Findley are given in the creep/time diagram shown in Fig. 14.

Examination of these curves shows that the nature of the creep phenomena for cellulose acetate varies markedly with the constant load applied. Findley recognizes two regions of constant rate

(Continued on page 527.)

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(1) *Oberg, Schwartz and Shinn, "Modern Plastics,"* 1943/**20**/*April*/87. (2) *C. S. Meyers, "Modern Plastics,"* 1942/**20**/*Oct.*/81. (3) *W. E. Gloor, "Ind. Eng. Chem."* 1947/**39**/*Sept.*/1125. (4) *"Plastics,"* 1947/**9**/*Oct.*/125, 527. (5) *Symposium on Plastics, A.S.T.M., Philadelphia* 1944, *Carswell and Nason.* (6) *Gloor. B.P.* 599,054 (7) *Welch, Hayes, Carswell and Nason, "Modern Plastics,"* 1946/**23**/*Oct.*/159, 196. (8) *W. M. Findley, "Modern Plastics,"* 1941/**19**/*Sept.*/57. (9) *Sookne and Harris, "Ind. Eng. Chem.,"* 1945/**37**/478. (10) *Sookne and Harris, "Textile Research,"* 1943/**13**(3)/17. (11) *Adams and Throdahl, "Modern Plastics,"* 1948/**25**/*June*/139. (12) *W. N. Findley, "Modern Plastics"* 1942/**19**/*Aug.*/71. (13) *"Modern Plastics,"* 1945/**23**/*Nov.*/153, 194. (14) *"J. Polymer Science,"* 1946/**1**(2)/63. (15) *"Industrial Plastics,"* 1947/**2**(11)/6. (16) *"Plastics" (Chicago),* 1947/**6**(4)/46. (17) *"Modern Plastics,"* 1943/**20**/*Mar.*/99. (18) *"Modern Plastics,"* 1945/**23**/*Sept.*/153. (19) *"Modern Plastics,"* 1942/**20**/*Oct.*/81. (20) *"Aviation,"* 1944/**43**/*June*/143; *ibid*/*July*/164; *ibid*/*Aug.*/163.

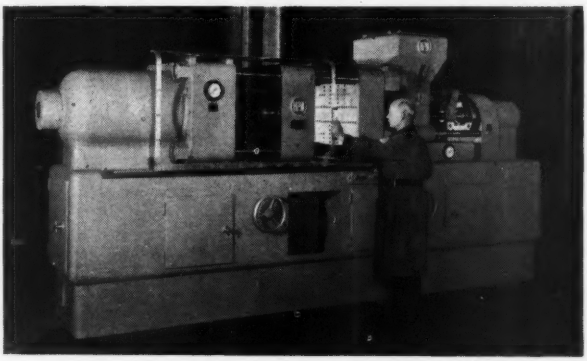
Plastics at the Machine Tool and Engineering Exhibition

OUR visit to the Machine Tool and Engineering Exhibition, held recently in London, did not prove unprofitable from the plastics viewpoint. In the first place, two of the exhibitors were actually showing injection-moulding machines, although we did not anticipate finding exhibits of this nature, but went to Olympia mainly in search of things useful in the actual making of moulds for the plastics industry.

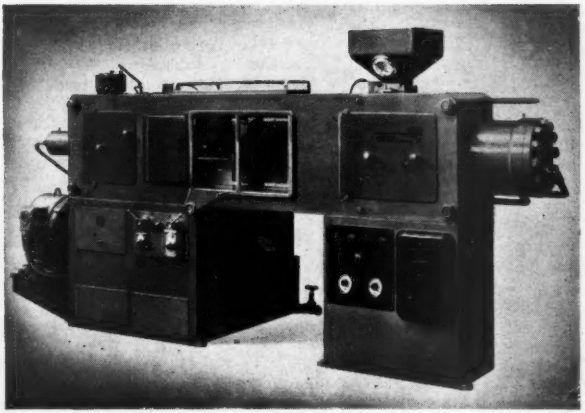
The exhibitors of plastics moulding machinery were The Projectile and Engineering Co., Ltd., London, and A. C. Wickman, Ltd., Coventry. The former showed their self-contained hydraulic automatic cycle injection moulding machine, to which we have already made several references in these pages. Wickman, acting as agents for The Hydraulic Press Manufacturing Co., Ohio, U.S.A., were showing the new H.P.M. 16-oz.-capacity machine, in which simplicity of control and operation are outstanding features.

In the H.P.M. machine the main operating valves are actuated by solenoids, directly mounted without intervening linkage. A single multi-flex timer is provided for controlling the clamp and injection actions. The operator starts each cycle by moving the clamp-operating lever, and a sliding-type safety gate prevents closing of the clamp while the gate is in the open position. Rapid die change-over is also made possible, because adjustments are not necessary when installing moulds of different sizes. The clamp ram advances until it meets with resistance, and this may be anywhere within the limits of the ram movement. The clamp force is applied centrally to the platen by an hydraulic ram of large dimensions, and is adjustable by regulating a convenient handwheel. It is also possible to limit the return stroke of the clamp ram so that a shorter ram stroke and consequently a faster press cycle can be employed, if the size of the mould will permit. Positive overload protection is achieved by automatically reducing the output of the hydraulic pump as the predetermined clamping force is reached. This automatic slow-down eliminates slam and shock to the moulds, and so increases mould life. The injection chamber is securely mounted on a steel cradle, which is held in accurate alignment on two tie-rods. The position of the cradle is adjustable to accommodate heating chambers of various lengths. The chamber is designed with a new interrupted wedge locking device which permits the removal of the chamber by simply turning it sixty degrees.

This H.P.M. injection moulding machine



H.P.M. injection moulding machine, capacity 16 oz. per cycle, by The Hydraulic Press Manufacturing Co., Ohio, represented in England by A. C. Wickman, Ltd.

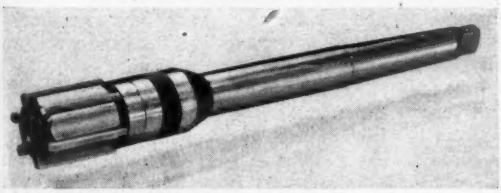


"Peco" injection moulding machine, capacity 4 oz. per cycle, by The Projectile and Engineering Co., Ltd., London (similar machines are made for 6 oz. and 12 oz. capacity).

has a maximum capacity of 16-oz. of material per cycle. Its plasticizing capacity is 100 lb. per hour, that being also the actual capacity of the hopper. The mould clamp pressure is 350 tons; pressure for separating moulds, 22 tons. The injection pressure on the material is 20,000 lb./sq. in. The maximum daylight opening between die mounting surfaces is 32 ins.; minimum mould thickness, 12 ins.; maximum clamp travel, 20 ins.

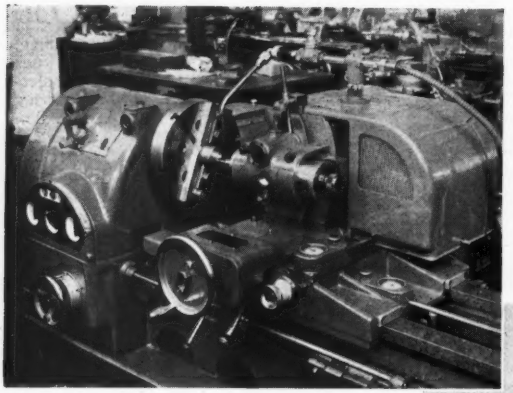
The Hydraulic Press Manufacturing Co. are now also making a giant 40-oz. "all-hydraulic" injection moulding machine, which opens up an untouched field for the plastics moulder, and this allows production of refrigerator parts, radiogram cabinets, large instrument housings and the like.

Particularly interesting among general machinery at the Exhibition was a special modification of a precision tool and die surface grinder, exhibited by the Abwood Tool and Engineering Co. Ltd., Dartford, Kent. This modification has been introduced for the grinding of thin plastic strips of unlimited length, width up to $4\frac{1}{2}$ ins., thickness 0.01 in. upwards, the grinding being done either wet or dry. Using this machine, a very good finish is obtainable according to the particular

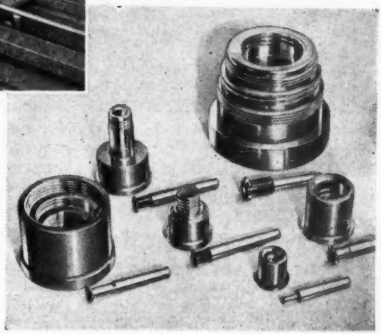


(Above) Expanding machine reamer of new design (Birmingham Tool and Gauge Co., Ltd.).

(Right) Surface grinder for thin plastic strips (Abwood Tool and Engineering Co., Ltd.).



(Left) Special thread-milling machine designed by B.I.P. Tools Ltd., and now made by The Coventry Gauge and Tool Co., Ltd. Shown below are typical moulding dies threaded by this machine, together with the cutters employed.



grinding wheel used, and size can be held to a very close tolerance. The machine will handle work to a limit of 0.0025 in., and has a production rate of 15 ft. per minute. All the dust from the grinding operation is sucked out underneath the machine, which is thus rendered particularly clean in operation.

B.I.P. Tools, Ltd., Erdington, Birmingham, co-operated with The Coventry Gauge and Tool Co., Ltd., in displaying a special thread-milling machine which has been designed for the purpose of cutting thread-milled pieces to be used in conjunction with plastics moulds. This machine was designed and patented by B.I.P. Tools, but is now being manufactured at Coventry.

Within the last few years the development and use of screwed plastic components in all branches of industry has considerably increased and many different applications, each embodying its own peculiarity, have been presented to the plastic tool manufacturer, who had to improvise machines and equipment to keep apace with each fresh development. It therefore became increasingly necessary to design a special-purpose machine tool which would embody all the features desired by the manufacturer of threaded plastic dies. Some of the difficulties which had to be considered were : (a) Shrinkage of the plastic component during the moulding process, which was often in the region of .008 in. per inch of thread ; (b) special thread forms ; (c) the production of precise lengths of thread, often in blind holes ; (d) right-hand, left-hand and taper threads terminating close to a shoulder ; and (e) the unblemished finish of the complete die. The thread-milling machine here illustrated has been specially designed to overcome all these difficulties in a speedy and efficient manner. Its maximum threading capacity is 3 ins., and work up to 18 ins. long can be admitted.

An important new tool shown by the Birmingham Tool and Gauge Co., Ltd., Handsworth, Birmingham, was an expanding machine reamer. Manufactured with a carbon-steel body and H.S.S. blades, adjustment is made from the front by means of a socket-head screw, and the position is locked with a knurled nut actuated by a hardened tapered collar. Grooves are milled between the blades to ensure effective swarf clearance.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Nest Eggs

Sir,—Our attention has been drawn to page 479 of your September issue concerning correspondence on "Nest Eggs."

The nest egg to which you refer is made solely for us by Healey Mouldings, Ltd., who forward any inquiries they may receive direct to us, and in this connection we received the inquiry from George H. Elt., Ltd., who, we are glad to say, are handling our product.

We are indebted to both these firms and to your good self for the business courtesy extended, and feel sure that you will not mind mentioning that the "nest egg" referred to is our own innovation and fully protected by provisional patents. POULTRY SUPPLIES, LTD.

Trinity Walk, Nottingham.

Staffing Problems

Sir,—It was recently disclosed by the House of Commons Committee on Public Accounts that large numbers of workers were still being trained for the building industry when it was well known that building schemes had been cut. We should like to suggest that the time has come when it would pay the country more thoroughly to co-ordinate its training methods.

My own company recently opened a large factory at Newcastle for the production of "Formica," which is a decorative laminated plastic with a large potential export demand. Staffing problems presented and still do present a major difficulty and we are ourselves having to undertake the complete training of all new employees. This has taken time and thereby lost us valuable foreign currency.

Under present conditions the flow of labour is closely controlled, and it should be comparatively simple also to forecast the relative needs of various industries and firms. Is it not possible to establish a planning board to co-ordinate, in respect of training, the needs of industry with the workers available? This could cover not only the immediate present, but could actually judge the probable requirements of the labour market some time ahead. Such a board might result in considerable saving to industry and help in solving our economic problems. I feel sure that leading industrialists would be only too happy to co-operate with the Ministry of Labour in Founding a plan along these lines.

G. MARTIN TURNER, Director,
De La Rue Insulation, Ltd.
84, Regent St., London, W.1.

Beryllium-copper Moulds

Sir,—We read frequently in the American plastics publications of moulds constructed in beryllium-copper by the hobbing process. We would be pleased if you could put us in touch with anyone in this country who could supply the material concerned. SILCOMS.

327, Bury Road, Bolton.

[EDITOR'S NOTE: The only concern in this country who regularly make beryllium-copper is Mallory Metallurgical Products, Ltd., Hazlitt House, Southampton Buildings, London, W.C.2. Beryllium-copper is exceptionally erosion resisting; the general reluctance against using abrasive but otherwise excellent heat and chemically resistant fillers is thereby overcome. There is also in existence another alloy, beryllium-nickel-copper, which is particularly suitable from this point of view. Information on the latter can be obtained from the Mond Nickel Co., Ltd., Grosvenor House, Park Lane, London, W.1.]

Electroplating on Plastics

Sir,—With reference to the letter under the above heading in the June issue of "Plastics" (page 313), we would inform you that our friends, J. W. Janes and Co., Ltd., 65, Harders Road, S.E.15, are carrying out the above process for the trade.

LONDON AND SCANDINAVIAN
METALLURGICAL CO., LTD.
London, S.W.8.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

ADHESIVES FOR PLASTICS.—Compiled for the use of architects, builders, cabinet makers, coach and carriage builders, etc., a new technical publication, "Formica Working Notes—Adhesives," has been issued by the Design Section, De La Rue Insulation, Ltd. This publication gives details of casein cements, and thermo-setting and thermo-plastic resin adhesives suitable for bonding "Formica" to other surfaces. The notes provide authoritative information and include names and addresses of manufacturers of the adhesives recommended. Copies may be obtained on application to Design Section, De La Rue Insulation, Ltd., Imperial House, 84, Regent Street, London, W.1.

TIPPED TOOLS.—Cemented tungsten carbide tipped tools made primarily for use in the machining of hardwoods, plastics and plywoods where the bonding glues have an abrasive effect on the cutting edge of high-speed steel tools, are described and illustrated in a 44-page technical brochure issued by Prolite, Ltd., Central House, Upper Woburn Place, London, W.C.1. These "Prolite" tools offer greatly increased tool life between regrinds. The present brochure gives detailed information regarding their use and the technique of successful regrinding.

SILICONE NOTES.—"Antifoam A," one of the Dow Corning silicone products, is used for the prevention and suppression of foam in a variety of aqueous systems, as outlined in Silicone Notes No. 214, issued by Albright and Wilson, Ltd., 49, Park Lane, London, W.1. It will suppress foaming in the manufacture and application of a wide variety of adhesives. In the synthetic rubber industry it finds use in the vacuum distillation of latex emulsions such as Neoprene and GR-S, and during the steam distillation of other butadiene-styrene copolymers. Concentrations ranging from 6 to 5,000 parts per million are employed.

NEW PACKAGE STRAPPING.—John Gosheron and Co., Ltd., of Gayford Road, London, W.12, announce that they have introduced a new packaging tape which neither cuts workers' hands nor damages the parcels it is intended to protect. This new material, known as BPI-Fortofix, has ample "give" without actual stretch. It conforms readily to the shape of the package, has a guaranteed tensile strength exceeding 70 lb. and a breaking strain of a good deal more than 300 lb.

OVERSEAS ECONOMIC SURVEYS.—Two further Overseas Economic Surveys, in the series published for the Export Promotions Department of the Board of Trade by H.M. Stationery Office, will be available shortly. They are Iran (Persia), and the United States of America, price 3s. 6d. Copies are obtainable from H.M. Stationery Office, Kingsway, London, W.C.2.

EXPORTS UNDER LICENCE.—The Board of Trade state that a new Customs Shipping Bill, numbered 63 A (Sale), has been introduced for use where goods exported under licence are entered with the Customs before shipment solely by reason of export licensing requirements. Supplies of the new form may be obtained from H.M. Stationery Office or through the usual agents.

F.B.I.—Sir Robert Sinclair has been appointed Deputy President of the Federation of British Industries.

MONSANTO CHEMICALS, LTD., inform us that, with the acquisition of additional accommodation at 8, Waterloo Place, S.W.1, the rearrangement of their London offices will be completed. With effect from September 11, 1948, the registered offices of the company has been transferred to 8, Waterloo Place, S.W.1 (Telephone: Whitehall 2913). All Sales Departments (excepting Export), and Monsanto International are now located at Victoria Station House, Victoria Street, S.W.1 (Telephone: Victoria 2255). The Export Sales Department is now at Allington House, Allington Street, S.W.1 (Telephone: Victoria 2416), and Accounting and Purchasing Departments at 37, Park Street, W.1 (Telephone: Regent 7321).

BAKELITE, LTD., announce the following new appointments:—Mr. W. E. Cooper, assistant managing director (commercial); Mr. F. J. Robinson, assistant managing director (production); Mr. G. Dring, research and development director;

Mr. C. C. Last and Mr. G. W. Hodds, joint general managers. All the above have been with the company for many years, and will continue to operate from the Head Office in London.

I.C.I. PLASTICS DIVISION.—The works at The Holme, Rawtenstall, opened during the war to produce "Perspex" acrylic sheet, is to be closed as from November 14. It is stated that this decision has been taken because Rawtenstall is the smallest of the I.C.I. factories producing "Perspex" and with a limited range.

E. K. COLE, LTD.—The Ekco Players presented a comedy thriller, "Such Things Happen," by Wilfred Massey, to appreciative audiences in the Works Canteen at Prittlewell on September 6, 7 and 8. The cast were drawn from all divisions of the firm, including the Plastics Division.

PETROCARBON, LTD., AND PETROCHEMICALS, LTD.—Considerable progress has been made in the erection of the Catarole plant. Provided that suppliers can keep to scheduled times for remaining deliveries, the first units of the plant should be started up by the end of 1948, and the remainder will be in operation by the autumn of 1949.

Styrene Co-Polymers, Ltd., has been formed jointly with Lewis Berger and Sons, Ltd. It will absorb Petrochemicals' total output of crude styrene for the manufacture of a styrene-based paint and varnish.

Arrangements have been made to form a company, Oxirane, Ltd., jointly with Lankro Chemicals, Ltd., to produce and market certain chemicals based on ethylene and propylene derivatives from the Petrochemicals plant.

A long-term agreement has been concluded with British Paints, Ltd., for the off-take of the entire production of Petrochemicals' indene resins.

Lieut.-Gen. Sir W. G. Lindsell, a director of Petrochemicals, Ltd., for the past two years, has now been elected chairman of the board in place of Mr. H. Stuart Ebben. Mr. Ebben has been chairman of Manchester Oil Refinery, Ltd., since its inception in 1938 and retains his seat on the board of Petrochemicals, Ltd.

MR. A. K. UNSWORTH, M.Sc., A.R.I.C., was the author of the article "Weather Report," published in the September issue of "Plastics" (page 459), which described the use of "Fuff" when making the film "Scott of the Antarctic." This light-density urea-formaldehyde resin material, made by Expanded Rubber Co., Ltd., has now also been used in small quantities in television, such as when producing the musical show "Balalaika," during September.

MR. RICHARD LONSDALE-HANDS and his associate designers recently held an exhibition of selected examples of industrial design at Commonwealth House, London, W.C.1. Exhibits of plastics interest included parts of projectors for cinema film. The prototypes for radio cabinets and a barometer, and other mouldings, were included among the photographs shown.

PLASTICS INDUSTRY GOLFING SOCIETY.—A competition was held at Little Aston Golf Club on September 9, when 14 members competed for the new trophy presented by Mr. E. Wall, of Healey Mouldings, Ltd. The fine score of 76 gross less 2 handicap equals 74 net was returned by the winner, Mr. W. F. Dale, who becomes the holder of the cup for the current year. Mr. W. R. Gibson was the runner-up with a score of 89 less handicap 14 equals 75 net.

NOTES FROM THE BRITISH PLASTICS FEDERATION

New Members

PLASTICS MATERIAL MANUFACTURERS' GROUP:

British Geon, Ltd.

MOULDERS' GROUP:

Litholite Insulators and St. Albans Mouldings, Ltd.

Annual General Meeting

The Federation's annual general meeting will take place on March 16, 1949, and the annual luncheon will be held on April 27, 1949.

Key Industry Duty

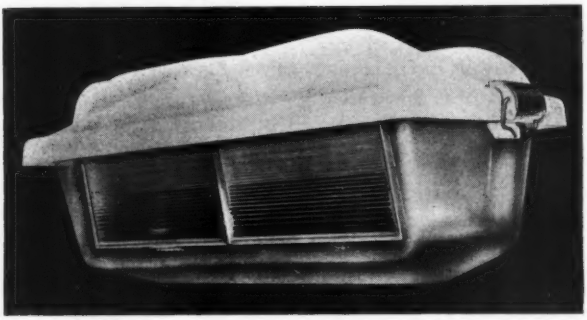
The application by the Federation for an extension of temporary exemption from K.I.D. for phenol, phthalic anhydride and maleic anhydride has been granted, and the exemption of these materials has been extended to December 31, 1948.

Imports of Moulding Powder

Imports of moulding powder during June and July were as follows:—

	June tons	July tons
Phenol formaldehyde ...	442	93
Urea formaldehyde	6	16
Cellulose acetate butyrate ...	16	17
Methyl methacrylate ...	6	—
Polystyrene	175	177

New Productions from the Moulding Shops

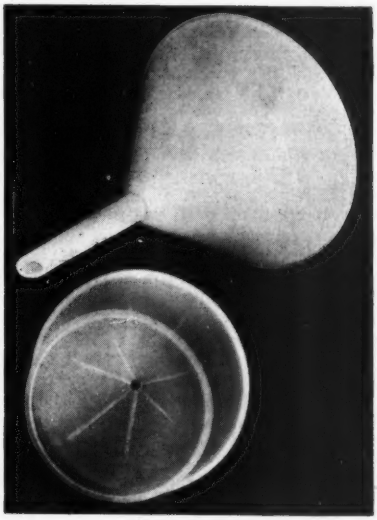


Street Lighting

A notable new departure in lantern design for street lighting, using horizontal burning sodium lamps was shown for the first time in public by Metropolitan-Vickers Electrical Co., Ltd., on their stand at the British Exhibition at Copenhagen. The new design embodies a " Perspex " top and refractor bowl, and the complete product is a lantern weighing only 17½ lb. The refractor bowl totally encloses the lamp and ensures control of the lamp output to provide an optimum light distribution. The bowl is hinged from a two-part cast aluminium alloy rib by a stainless steel wire ring. The hood is shaped from $\frac{3}{16}$-in. dense opal " Perspex "; the bowl is of clear " Perspex " of the same thickness, with specially designed refractors sealed to the sides. The method of manufacture adopted permits the refractors to be made to very fine limits, and, in addition, the opal hood serves as an efficient diffuse reflector to the upward light emitted by the lamp; this produces an attractive appearance when the lamp is burning. The manufacturers believe that this is the first all-plastic totally enclosed refractor street lighting lantern so far produced.

Polythene Funnels

The acid and alkali-resisting nature of polythene, the ease with which it can be moulded, and its general stability and strength, all contribute to make it an obvious choice as a material for any receptacles or appliances which have to come in contact with chemicals. J. F. Kenure, Ltd., of Feltham, Middlesex, are to be complimented on the design of the polythene funnels here illustrated. Such features as external ribs to prevent air locks, and internal ribs to assist in the removal of filters have advantages. These funnels are available in four sizes and have been designed to nest in sets, which considerably reduces the bulk of packing. The decision to sacrifice the facility of nesting each size independently seems to have been a wise one, as the alternatives would have been either to reduce the wall thickness of the nozzle and thus reduce the degree of rigidity below that necessary to support the weight of the loaded funnel, or to reduce the length of the nozzle and increase its taper.



Motorcar Windscreens

The application of acrylic plastics in the design of motorcar bodies was discussed by W. F. Bartoe at the recent Technical Convention of the American Society of Body Engineers. The author pointed out the difficulties of using acrylic plastics as windscreens for road vehicles owing to risk of scratching by road dust.

Quality Control in Plastic Moulding—XI

In this present article the value and applications of restricted limit fraction defective control methods are contrasted with those associated with ordinary fraction defective charts, etc., and the numerous advantageous features are noted. Attention is also directed to the number of useful refinements or adaptations which may be made in regard to control chart construction and usage, with particular reference to group-type control charting procedures as applied to certain forms of plastic moulding operation.

By W. M. HALLIDAY

CONTINUING the interesting study of the methods to be followed for constructing and applying fraction defective control charts of the restricted limit type, which subject was dealt with in the preceding article in this series, it will be well worth while to devote a little further attention to observe and summarize the various valuable advantages accruing from such methods of moulded component inspection.

In the first place it deserves to be reiterated that the restricted limit kind of control chart does ensure that adequate warning is given to the inspector, and those other individuals vitally concerned with the moulding process generally, *immediately defectives* are being produced.

From our previous discussions on this subject, it will be recalled that this is in marked contrast to what takes place when using fraction defective charts based upon normal control limits. The control datums on the charts in this latter case are determined from previously ascertained average levels of defectives found to be associated with the satisfactory working of the moulding tool. Sampling batches of specific quantities are taken, the number of defectives occurring is then averaged out over a number of similar batches, which mean value then determines the position of the control datums on the charts.

Thus with the use of ordinary-type fraction defective control charts, a certain volume of defects must always be allowed for, and warnings are vouchsafed to the inspector only when variations in the moulding process arise to cause departures from that average level of defectives.

The latter inspection and control method will, of course, prove quite satisfactory on large numbers of plastics moulding operations where the components being produced have not to be retained within, say, very close dimensional limits of variation. Where precision-type plastic mouldings are required, however, control charts of the restricted or compressed-limit type must be employed in order to keep the defective ratio as small as possible, or even in some instances non-existent.

This latter check is obtained by instituting artificial limits of permissible error which are in effect very much finer or smaller than those required on the finished moulded products, these artificial limits then being employed purely for checking, inspecting, and charting the progress of the production. By this simple method, it has been demonstrated, scrap or defectives may be virtually eliminated, and the entire production stabilized within very close dimensional accuracy and uniformity.

Another point worthy of close attention illustrates how restricted limit control charts may be usefully employed.

With ordinary-type fraction defective charts set up to control production where only a very small percentage of defective components can be tolerated, in order that the inspector may be reasonably certain that at least one or two defectives

will occur in each sample batch selected for inspection, the quantity of components in such sample batches may have to be very large. In certain instances this batch quality may be so great as to make economical inspection difficult, due to the large amount of time required for the inspection of each individual member of the batch.

Restricted limit control charts, on the other hand, permit relatively small size sampling batches to be taken without any loss of accuracy or reliability in the control over the production,

Another important advantage to be derived from the restricted limit chart lies in the greater assurance afforded to the inspector, mould user, and mould setter. Each of these persons by referring regularly to the control chart exhibited on the moulding press will be enabled to detect the development of any undesirable deviations in the dimensions or other features on the moulded products. This will be found extremely valuable in the case where precision-type mouldings are being produced from multiple impression tools, in which circumstances the volume of parts produced within a given period may be very large. The occurrence of slight variations in the defective rate might therefore involve the creation of a large quantity of defects, with unduly high costs to be absorbed in their correction or replacement.

Since such charts can easily be arranged to demonstrate the first occurrence of defective parts, the inspector particularly will be given greater confidence throughout the production run in his ability to control quality.

Where the individual moulded articles are of large size or intricacy of form, making each part of considerable value, the limitation in the quantity of defectives or scrapped parts will be considerable. By controlling the scale of defectives in the manner previously explained by the use of restricted limit control charts very material savings in the total cost of the work can usually be effected, since delays in the production run will be obviated, and the quantity of parts requiring correction at the end of the production will be very much less than will arise when normal control charts are employed.

A further useful feature is that the restricted control chart can be used with equal facility and value in connection with the production of moulded components having to be maintained either with strict dimensional limits of error, or in those cases where the stringency is applied to surface finish, weight, strength, or other similar physical features to be possessed by the finished part. Thus restricted limit charts may be employed not only when examination of the component is by gauging or measuring some particular dimension, but whenever examination and inspection is by comparison with some known accepted standard. Such a standard has, of course, to be readily capable of checking, as, for example, the weight or finish, or strength of an article.

Where examination of the component consists of testing a dimension and the taking of measurements generally it will be advisable to employ direct reading visual types of measuring equipment, rather than the ordinary kind of " go "—" not go " gauge.

It will be appreciated from the preceding discussions on this topic that this is an exceedingly important point because the much finer tolerances set-up for use in conjunction with the restricted limit chart will not be readily measurable by means of the " go "—" not go " kind of gauge.

Likewise it will be observed that the author stresses the introduction and use of such direct-reading measuring devices, having visual recording means to show the variations occurring on the part being checked in reference to a known correct standard value.

Plug gauges, micrometers, and similar adjustable measuring or rather gauging instruments, whilst exceedingly good when used by a skilled or experienced operator, are very apt to be wrongly set or mistakenly inter-

preted by the not so well experienced user. In addition, appliances such as micrometers have an annoying tendency to become accidentally disturbed and for this reason have to be very carefully handled. Furthermore, the accuracy of a micrometer reading depends to a considerable degree upon the sense of touch possessed by the user. It is common in moulding shop inspection practice for variations of as much as 0.002 in. to occur purely from this cause. If the inspector has an exceptionally heavy touch it will be quite easy for him to inspect and pass, in perfectly good faith, parts which are actually over or under size when measured up by a person with a more sensitive touch.

Need for Correct Type of Measuring Appliances

For all the foregoing reasons, therefore, it will be advisable to install those kinds of measuring appliances which do not depend upon the user's sense of touch at their initial setting or in repeated use. When using control charts of the restricted limit type, therefore, their success or otherwise may be largely conditioned by the quality of the measuring or gauging equipment employed, hence the need for the correct selection of such equipment.

Yet another valuable advantage resulting from the application of the restricted limit control charting method is to be found in the gradual elimination of numerous minor snags and faults associated with the moulding tool, its method of operation, the actions of the mould operator, or with the moulding press or injection machine.

Since the slightest deviations in the size or other features possessed by the moulded article will be immediately shown up by the positions of the plotted points on the restricted limit chart, the causes of these variations will similarly tend to be more quickly determined and corrected.

For these reasons it will usually be found that after the production has been so controlled for a short space of time innumerable seemingly unimportant snags and faults will have been revealed to the notice of the mould setter or maintenance toolmaker, and due rectifications effected.

Thus in a very short space of time the entire moulding process will become improved, and the quality and accuracy of the moulded articles appropriately promoted. This feature incidentally is one new users of quality control methods often notice to arise, when such methods are introduced to a moulding operation for the first time. If space permitted, the author could give numerous illustrations of this, which have been reported to him from time to time. Detailing of such examples, however, need not be necessary, because it will be almost self-evident that when the quality and accuracy of the component are being controlled with close stringency, it is inevitable that the closely allied method of producing the component will have to come under stricter control and supervision.

Indeed, so much is this the case that the author knows of instances where quality control methods have been instituted in a moulding shop, chiefly, not because the products have proved unacceptable to the client on account of variations in quality or accuracy, but because it was suspected that the moulding procedures employed were offering too many loopholes for the formation of defective or scrapped parts, or were characterized by excessive delays and unduly retarded production.

By introducing quality control methods, especially of the restricted limit kind, a gradual yet very pronounced improvement was effected not only in respect of the quality of the finished moulded products, but also in the methods, machines, and moulding tools employed in the production process.

With compression type moulding especially, there are a large number of factors difficult to control. Some are purely manual ones, others are partly manual and partly mechanical. The inability to control such factors is very often the cause both of defective work and excessive moulding costs.

To give one single example, take the case of a multiple impression compression mould having, say, 48 cavities. Before such a mould can be placed on to the press platen, each cavity will have to be cleaned out thoroughly to shed all residues from the previous moulding pull. This operation is generally performed by means of a small compressed-air jet to blow out particles of material, or else a small brush is used. Next, the proper volume of powder charge will have to be measured off and placed in each cavity area. Then, if insert members have to be employed, each insert piece will have to be placed within the cavity and correctly located therein. This accomplished, the operator will next have to ensure that the parting-line surfaces of the mould forces are perfectly clean, and the mechanism of the tool in generally sound condition. Cores will have to be re-inserted into their housings, and ejector plugs brought back into the closed position.

All these operations dependent upon personal care and attention have to be performed before the mould is placed upon the press.

Before the moulding cycle can be completed, other equally important manual operation will have to be carried out. Thus the mould forces will have to be closed with proper pressure, and brought up to the moulding temperature. The correct cure time will also have to be watched and checked by the operator.

Short of very closely controlling the quality of the finished products in the manner provided for under a system of quality control by charting, it is difficult to see how all these somewhat indeterminate factors can be properly supervised and controlled. Because of the ability of quality control methods to assist in this direction, the author would urge its more widespread adoption even in cases where the accuracy or finish of the products may not be important.

Enough has now been mentioned to illustrate the many weighty advantages which may be expected from the introduction of quality control by fraction defective. Doubtless other and equally valuable benefits may be secured in applying the method to a particular moulding operation which has formerly proved difficult in some respect.

It is now necessary to make a brief reference to certain other refinements or adaptations which may be made in ordinary control methods in order the better to meet special requirements.

Interpretation of Average Level of Defects

On the fraction defective control chart it will often be found extremely helpful, for the better guidance of the inspector, if the average number of defective components to be anticipated from a given sample batch is denoted by a bold datum. This figure, it will be recalled, is the one taken for the determination of the location of the control limit datums on the chart.

If during a normal production run plotted points are seen to congregate predominately around or *above* this average defective datum line, a deterioration in accuracy or quality, or both, would be at once suggested to the inspector. Providing such plotted points do not pass outside the control limit datums, the production may be regarded as being still under control, yet possessing strong tendencies to pass out of control if unchecked.

Should it be found, on the other hand, that the plotted points lie well *below* the average defective datum, this would indicate that some improvement had taken place at some point in the production procedure, which might well merit closer investigation in an endeavour to ascertain whether such improvement had come about accidentally or as a result of some newly introduced factor, and whether it could be maintained.

By closely watching for these signs, the inspector and mould setter will often be able to forestall a serious mould failure, or, contrariwise, uncover the need for taking suitable action to ensure that a previously unaccountable improvement be maintained throughout the remainder of the production run.

Another useful function performed by the provision of a special datum representing the average level of defects per sample is that the continued congregation of plotted points either above or below the datum of the average number of defectives to be expected will constitute a clear warning that fresh factors have entered into the production cycle, as a result of which new control limits should be determined from a fresh quantity of sampling batches. It should be noted particularly that this result would be derived before any serious quantity of defectives had been produced.

With the normal quality control chart, however, before the inspector would be made aware that new factors had come into play in the moulding process, resulting in a marked increase or decrease in the level of defectives being produced, quite a large number of actual faulty components may have been moulded. Any action or provisions calculated to ensure greater precision in this regard will be well worth while considering.

Compounding Sampling Batches

We turn now to another very interesting and useful form of adaptation to fraction defective control charting methods which the plastics moulder can often turn to good account.

As already explained in previous sections in this series, the size of sampling batch is of paramount importance, especially when taking same to determine the disposition of the control limits on the chart. The size of sampling batch very largely conditions the degree of accuracy, uniformity and reliability of the calculated average values derived therefrom, and which are subsequently used for fixing the positions of the control limit datums on the chart. Thus the larger the sampling batch, the more closely will the ascertained average value be to the state of the actual production.

This fact may be advantageously used to promote even more accurate interpretation of the plotted results depicted on a quality control chart, in the manner to be explained below.

Let us consider the case of a plastics moulding process where the inspector finds that plotted positions on the chart are increasingly approximating near one of the control limit datums, so much so as to predominate above the average level of defectives permissible to the job.

On the basis of this information he decides that some unauthorized occurrence has taken place somewhere in the process which will in a short time cause an undesirable increase in the scale of defectives being produced. But before taking action along the lines of stopping further production in order to examine the moulding tool, etc., he wishes to obtain a further more exhaustive check from the data afforded by the sampling batches being selected.

Such a check for confirmation or closer elucidation may be quickly and reliably taken by compounding or combining the results obtained from several sampling batches in the following manner:—

The total quantity of defectives is ascertained from three or four successive sampling batches. These latter, of course, are taken and checked up in exactly the normal manner. The next step is to determine what is termed the "check limit," which, in practice, is based directly upon the quantity of defective parts which would have been expected in the combined sample batches (three or four) at the original average level previously used for determining the positions of the control datums on the control chart being used.

An actual example will best illustrate this method, which is really very simple and easily derived from the normal procedure required for ascertaining ordinary control limits.

For example, suppose the control chart to be equipped with control limit datums at eight defectives per sample, based on an average of 2.57 expected defectives per sample, and three sample batches were compounded, the new "check limit" would be ascertained by the calculation 3 by 2.57, which equals 7.7 defectives per sample. By referring to the tables in "A First Guide to Quality Control," a

booklet already mentioned in this series, 7.7 defectives per sample would result in a "check limit" of 16 for the combined samples in the compounded batch.

Having ascertained this information in the above way, new additional control datums would be inserted in the chart, and for a short period at least of subsequent production, compounded sampling batches would be taken, each being equal to three normal sample batches.

In operation such a modified control chart would be interpreted as follows: Should the total number of defectives in the compounded sampling batch *exceed* the "check limit" derived in the aforementioned manner, the inspector can reliably accept it that the quality of the production and moulded parts has declined, and that a prompt examination of the moulding tool, etc., is necessary.

As will be appreciated, this method provides a very quick check-up on any suspected deterioration in the performance of the moulding process, and will often prove of great assistance to the inspector in confirming or verifying undue variations which occur in the process under control.

Introduction of Warning Control Limits

Very often with some forms of plastics moulding it becomes advisable to provide what are known as warning limits on the control chart, so as to aid the judgment of the inspector.

These limits may sometimes be employed as an alternative to compounded sample results. It may be preferred to have warning controls on the chart, based, say, upon the sample results of every 10 or 15 sampling batches. The inspector would then expect one sample result from the above size of group to give plottings on the control chart either exactly on or outside those warning control limit datums.

The positions of these "warning limits" upon the ordinary form of control chart would then be determined in the following manner: First, the maximum number of defectives per sampling batch which could be tolerated would be computed, this result being compounded over the 10 or 15 sampling batches selected. By referring to the above-mentioned tables, the positions of the datums would then be found.

Usually such "warning limits" will be located slightly outside the normal control limits applicable to the job, these latter having been based, of course, upon the results obtained from single isolated sampling batches in the way previously explained. The inspector dealing with the production would then know that even though plotted points representing variations in the quality, etc., of the components being produced, occurred beyond the normal control datums, but within the "warning limit" datums, the permissible scale of defectives was being adhered to.

One special word of warning deserves to be given in respect to all the foregoing modifications to the ordinary fraction defective control and charting methods. Considerably more care will obviously have to be taken in regard to the selection of individual samples in each sampling batch.

The customary method employed in plastics moulding activities is to take one or two of the "last-off" products. This practice has a tendency to make the quality or accuracy of the product appear more uniform and steady than it may actually be. It will be apparent that if, say, 10 individual components are taken consecutively as they are produced from the mould, they are more apt to appear uniform than 10 components selected at random over a period of moulding production.

The practical outcome of such a tendency will be to locate the modified control limits of the kind just described too close to the drawing limits. For this reason, therefore, when using such modified control limits, either of the compounded, or warning type, it will prove far more reliable and safer if samples are taken quite at random from the tray containing the mass of components which has accumulated in the interval since the last sample was taken.

Group Type of Control Charts

It will have been appreciated throughout all these discussions that the introduction of quality control methods inevitably must entail a certain amount of clerical work on the part of the inspector. Charts have to be constructed based upon the collection of data, calculations have to be made, and when the charts are put into operation further clerical work is necessary to convert them into reliable running commentaries of the production operation.

In certain cases, where the nature of the moulded product permits, this clerical work may be reduced quite usefully by the inauguration of what is known as the "group control chart."

One of the great advantages of quality control procedure in general is that it can usually be quite easily and readily adapted to suit any set of particular circumstances associated with a given moulding or machining operation. Such adaptations can often be successfully devised and applied, providing the fundamental principles and methods underlying quality control are fully understood.

To prove most effective, any scheme of quality control must to some extent be constructed around the specified product and the circumstances surrounding its manufacture. As previously intimated, such a scheme of quality control must always take into consideration the nature and quality of the manufacturing equipment and facilities available, the kind of inspection appliances capable of being employed for the gauging or checking of the finished components.

The type and skill of the machine or mould operator to be employed on the production operation will also have a very important bearing upon the precise form of the quality control procedure to be instituted. All these, and similar factors, will have to be adequately considered when the question arises of which kind of quality control method is to be decided upon.

It sometimes happens that the same moulded article has to be made from two or more identical moulding tools, each of which is used in conjunction with a separate injection machine, or moulding press, depending upon the character of the article. When such productions have to be made simultaneously from each of these separate and independent machines and tools, the collection of the preliminary data required for the determination of the control charts, as well as their subsequent compilation covering a production run, might involve an inspector in a considerable amount of clerical work. Moreover, it will be found that much of this clerical work is of a duplicatory nature, since most, if not all, of the component features, and the circumstances of its production will be identical in every respect.

This difficulty of repetitive clerical operations may be overcome to a very large extent by introducing into the combined production sequences a modified form of control chart known in quality-control parlance as "group control charts."

It must be stated at the outset that this form of chart is, indeed, only the logical development of the more simple forms of control chart already extensively explained and illustrated in the earlier sections of this series. They are worthy of a little detailed consideration by plastics moulding production engineers and works inspectors, not because they can be very widely applied to moulding operations, but because they do indicate yet another interesting way in which normal control charting means and methods can be adapted to meet special requirements.

The principle underlying such group-type of charts is briefly that one composite form of chart or graph is employed to cover a whole group of identical or closely similar products.

They can be applied best where production is continuous, as, for instance, in most forms of injection moulding, or when repeated batches of the same parts are to be produced at more or less regular intervals. Moreover, group-control charts, etc., as also is the case

with ordinary forms of quality-control methods, can be applied with equal facility and success in the small moulding shop as well as in the large one. This is worth stressing here, since many people have the idea that quality-control methods are really only applicable in the case of the large works where component production takes place on a vast scale, and when as a result the amount of inspection work is very great.

The methods of determining the values for the group-type control chart, and also how these amended types are applied to a particular moulding operation, can best be understood by taking an actual example to show how these various points are ascertained in turn.

The example selected for this explanatory purpose comprises a small injection moulded sleeve upon which component three dimensions have to be closely controlled as to variations and conformity with specific drawing tolerances. The outside diameter, overall length, and diameter of a small, shallow recess are the three critical dimensions involved.

Each mould has 12 cavities, and two such identical moulding tools were employed. Exactly the same procedure of mould operation was required, and each tool was mounted upon an injection moulding machine of the same type and capacity. In short, as far as practicable, all the mould and machine operating factors were identical in every respect. The operators, too, were regarded as being of about equal skill and experience in handling such machines and moulds. It should be explained, however, that the moulds were of a very simple design, having straight-line ejection, fixed-core members for forming the bore of the sleeve-like components, and, of course, no complicated provisions such as the application of inserts or the manual operation of core pins, etc.

Factors Influencing Control

First it is necessary to mention in some detail the factors affecting control, or rather those factors it was assumed would influence control by charting methods.

It was found at the outset of this dual moulding operation that slight variations existed in the cavity sizes over the two moulding tools. Such variations, however, whilst being very slight, could not be permitted to obtain, and accordingly the preliminary step was to check each cavity by measuring the diameter of the produced components very carefully over a number of injection shots from each machine.

Readjustment was then made of the affected cavity forms, so that complete and reliable uniformity of cavity size was secured.

The second factor to be dealt with related to the provision of precisely identical working instructions for the two machine operators. This was accordingly issued and covered such items as mould temperature, overall moulding cycle time, length of dwell before opening the mould after each shot, method of ejection, amount of water to be passed through the mould per cycle, pressure on the injection plunger to be employed, heat of the material in the hopper and fed through to the mould, and so forth.

The third factor to be considered at this preliminary stage was concerned with the gauging equipment issued for use with the inspection of the components thus produced. Here again it was deemed absolutely essential that identical measuring appliances were made available to the inspector, these being situated adjacent to each moulding machine.

It may now be asked why two complete sets of gauging equipment were considered necessary. The reason is that after weighing up all the features surrounding this particular moulding job it was considered unadvisable to provide only one set of gauges and measuring devices, owing to the fact that such tools would then have to be repeatedly disturbed and moved over to the second moulding machine. It was, indeed, found that such disturbances very seriously affected the setting and subsequent accuracy of the gauges.

It should also be pointed out that, for

(*Continued on page 562.*)

The Microscopic Examination of Plastic Materials

VII.—Mouldings (Contd.)

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AN illustration in the preceding article (Fig. 328) showed the existence of certain evidence pointing to the internal cavities of the coconut-shell particle elements being filled with resin. It is proposed, in view of this, to examine further the particle in question at a still higher magnification, so that the maximum amount of information may be obtained.

Fig. 329 shows the particle under discussion at 600 diameters. This photograph clearly shows the minute structure of the shell element. The internal cavity will be seen to be open to the outside at the end of the cell marked "A," and, in discussing this particular example, this fact must be borne in mind. However, it will be noticed that the cavity as a whole shows distinct signs of being filled with resin, by the presence of numerous small bubbles and two large ones marked "B." The presence of these voids in a resin mass is now a familiar feature of the structure of the mouldings so far examined, and the bubbles may be taken as being indicative of their presence; but it should be remembered that the absence of bubbles does not necessarily indicate the absence of resin, as it has been demonstrated that clear resin masses of appreciable size may exist without showing any bubbles present. In this latter case, however, crazing of the resin in greater or lesser degree may be detected by a study of the mass in section.

Regarding the illustration under discussion, it will be seen that the filler particle marked "C" also shows the characteristic signs of being filled with resin. The particle "D," on the other hand, does not show this very clearly, chiefly by reason of its being seen in transverse section and also slightly out of the plane of focus. In the cases illustrated the particles have one end of the lumen open to the exterior, and it is highly probable that the resin filling the cavities entered by this means. There would not be a great deal of hindrance to this process, due to the rigid nature of the cell walls. Furthermore, the presence of the numerous pit channels may be expected to help by allowing the contained air a means of escape, thus ensuring a complete filling of all the cavities existing in the structure of the cell. This latter then becomes a completely impregnated unit, embedded in the continuous matrix of resin.

The matrix is termed "continuous" for sake of simplicity; in point of fact it is far from being in this ideal condition, as the presence of numerous bubbles of

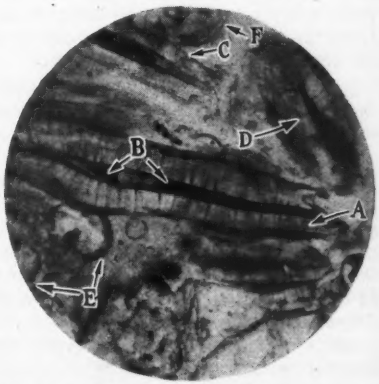


Fig. 329.—Coconut-shell filled moulding: transverse section showing surface irregularities. Mag. 600 diameters.

appreciable size indicates. In the resin filling the shell elements there are bubbles of various sizes, and in the matrix there exist much larger voids, such as those seen at "E"; one which is larger than usual is seen at "F." Again, the question as to the nature and origin of these voids arises: whether they are entrapped air pockets or bubbles formed by water vapour and other volatile constituents vaporized during the processing. As has been previously pointed out, this is not definitely established as yet, but in view of the temperatures and pressures employed in the moulding cycle, it is probable that the only air trapped in the structure of a moulding is that which has already been shown to exist in situations such as the vessels and tracheids of woody tissues. This being so, there is a certain amount of justification for assuming that the bubbles in the matrix result from the curing of the resin.

In the case of the coconut-shell filler, it would appear that the chances of trapping air inside the filler elements are less than those existing with fillers composed of soft woody tissues. This is probably due to the rigid nature of the shell particle, which seems to be able to withstand the pressures used and which, in the case of wood tissue, resulted in closing the ends of the vessels. Thus it will be appreciated that the shell particle lends itself to better impregnation by virtue of its structure and the nature of the material of which it is composed.

In this study of the coconut-shell filled moulding, we have so far dealt only with the general aspects of the appearances presented, and therefore it is expedient to examine the structure in greater detail from the point of view of the characteristics of the filler particles and their effects on the behaviour of the resin, if any. With this object in view, an examination of the section reveals that information of the desired nature is best obtained by examination of those particles seen in longitudinal section.

Fig. 330, at a magnification of 100 diameters, gives a clear indication of the general appearance of a particle of this

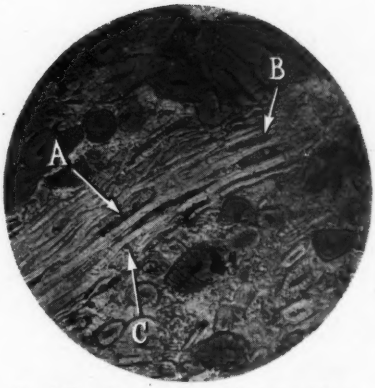


Fig. 330.—Coconut-shell filled moulding: transverse section showing long elements. Mag. 100 diameters.

nature, which may be considered as being a long unit, in contradistinction to the nearly spherical units more generally found and seen to be surrounding the particle in question. In this latter it will be seen that the cell walls are somewhat thinner than those of the particles seen in transverse section. This is due to the long particle having its origin near the outer surface of the shell, where the narrow transition zone in which the change from the thick-walled shell particle to true coir fibre takes place. In consequence oft his, the particle may be regarded as being a typical transition element; therefore the comparatively thin walls are more to be expected than otherwise. As a result of this structure, the internal cavities of the cells are large, thus facilitating the study of their contents, which are seen to consist of resin, as indicated at "A" and "B," where, even at this magnification, the presence of the familiar bubbles is to be noted.

However, it will be appreciated that in spite of the thin walls, there is very little evidence of the cells showing signs of collapse—indeed, it is probable that this particle has withstood the effects of the forces encountered in processing to the same extent as the thicker-walled filler particles. This is evidenced by the appear-

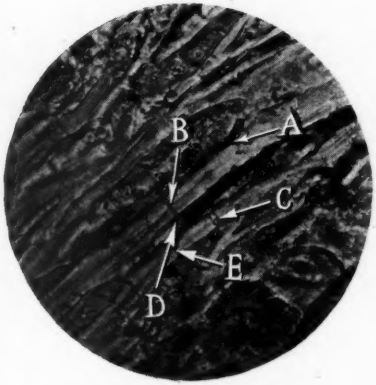


Fig. 331.—Coconut-shell filled moulding: transverse section. Mag. 500 diameters.

ance of the wall structures, such as pit channels, which may be picked out in this illustration. In general, the particle will be seen to show a high degree of impregnation not usually encountered with the softer filling materials. This is due, as we have already seen, to the rigid nature of the structure allowing the resin ample time to infiltrate the whole mosaic. There is, however, one point which might appear puzzling at first sight, this concerns the filling of the cells located at and near the centre of the particle, which are complete entities in themselves; that is to say, the main internal cavities are not in communication with those adjacent, except by means of the narrow pit channels. In spite of this, however, they are filled with resin to the same extent as those whose cavities are open to the exterior. This indicates that the resin has found ingress to the internal cells by way of the pit channels, which have been shown to form an intercommunicating network throughout the structure of the shell.

In order to be sure of this point, it is desirable to examine the particle at a higher magnification so that this assumption may be either confirmed or denied. Thus, in Fig. 331 we see a portion of the same particle at a magnification of 500 diameters. The portion shown is that marked "A" in the previously considered illustration, and similarly marked in that now under consideration. From this photograph it will be seen that the "A" portion is a cavity in one of the more centrally-placed cells of the particle, and the characteristic appearance of the resin filling it is apparent. The bubbles of various sizes are seen again to be present. The pit channels are clearly seen to be present, such as those marked "B" and "C," and it is very evident that these delicate structures—that is to say, delicate by virtue of their size—have not been subjected to any distortion by the moulding pressures. This may be taken as a good criterion on which to base the assumption that the structure of the particle in general has not undergone any physical or dimensional alteration through this cause, as it is reasonable to suppose that if this were the case, then the minute pit channels would be the first portion of the structure to show signs of this.

It will be seen on examining the channels marked "B" and "C" that they are the means of connecting the internal cavities of three cells, for that marked "B" connects the cavity "A" to that marked "D," while the channel "C" connects the cavity "D" to the one marked "E." This latter is not quite as clear as it might be, because the cell in this case happens to be sectioned at an angle and the portion marked "E" illustrates only a small part of the bottom of the cavity; this is evidenced by the appearance of the pit channel "C," which is clearly seen to be directed somewhat upward, thus exhibiting the upper orifice as an ellipse. Furthermore, the portion of the cavity shown at "E" is a little below the focal plane, thus indicating that the major portion of the cavity was above this.

However, in general, the cavities visible in this illustration are all seen to be well filled with resin, and numerous pit channels may be seen to connect these cells together. Therefore it is not surprising that the whole structure is thoroughly impregnated with the resinous matrix, and a close approach to the ideal concept is attained;

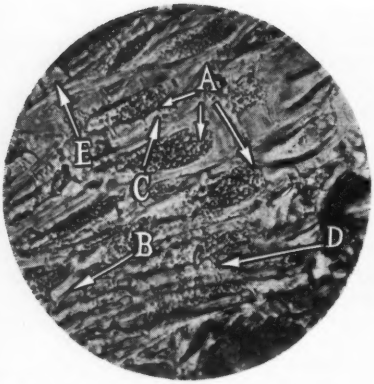


Fig. 332.—Coconut-shell filled moulding: transverse section showing pit channels. Mag. 500 diameters.

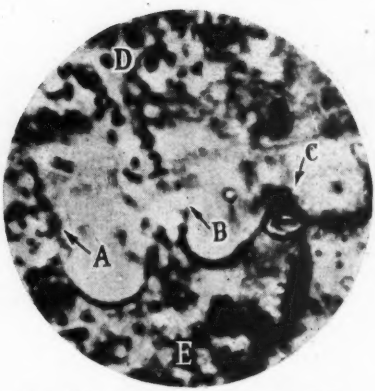


Fig. 333.—Coconut-shell filled moulding: transverse section showing pit channels. Mag. 1,600 diameters.

particularly is this so when it is appreciated that the structure throughout the filler is subject to very little variation, and this condition should therefore be present throughout the moulding.

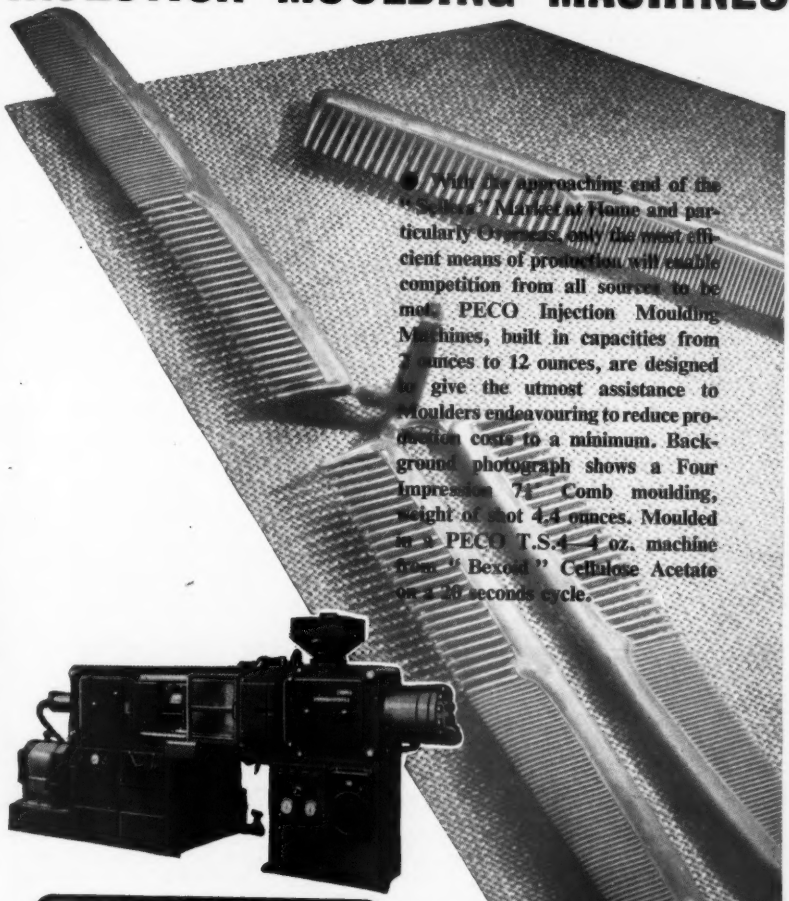
Despite the information obtained from this illustration, it is not quite clear whether or not the pit channels are filled with resin, as these are too small in the photograph for one to be quite sure on this point; therefore, suppose we continue the examination of these structures at higher magnifications in order to remove all doubt regarding this. Fig. 332 shows another long particle in longitudinal section at a magnification of 500 diameters. In this particle there are numerous cell cavities to be seen, clearly showing that they are well filled with resin, as those indicated at "A." The latter substance in this case is also seen to exhibit a greater preponderance of bubbles than in the previously examined case, and in this respect it serves a useful purpose, inasmuch as it can be definitely established that the pit channels are also filled with resin.

There are many clearly defined examples of these latter structures present, as at "B" and "C," but the best example of its kind is seen at "D," where the channels are somewhat larger than usual and show distinct signs of their being filled with resin. It should be borne in mind, however, that this particle is also one originating from the transition zone, and in consequence the slight difference in structure such as the thinner cell walls, is evident, and may be compared with that of a true shell particle shown at "E." As a result, the long particles possessing thinner walls are not so highly lignified as are those of the shell proper, in consequence of which they are lighter in colour and more transparent, and hence furnish greater detail of structure under the microscope.

Thus the lamellar nature of the wall material may be distinguished with relative ease and is seen to show no signs of being affected by the resin, which appears to have penetrated the structure of the particle by way of pit channels only.

In order that this may be established with a reasonable degree of certainty, it is expedient to examine the channels at higher magnification; accordingly Fig. 333 shows three of the channels, "A," "B" and "C" (marked "E" in the previous illustration), at a magnification of 1,600 diameters. From this photograph it is evident that the channels indicated connect the two cavities "D" and "E" and there is little doubt about the contents of both channels and cavities, which are obviously

INJECTION MOULDING MACHINES



With the approaching end of the "Seller's" Market at Home and particularly Overseas, only the most efficient means of production will enable competition from all sources to be met. PECO Injection Moulding Machines, built in capacities from 2 ounces to 12 ounces, are designed to give the utmost assistance to Moulders endeavouring to reduce production costs to a minimum. Background photograph shows a Four Impression 7" Comb moulding, weight of shot 4.4 ounces. Moulded in a PECO T.S.4—4 oz. machine from "Bexoid" Cellulose Acetate on a 20 seconds cycle.

THE PROJECTILE AND ENGINEERING COMPANY LIMITED

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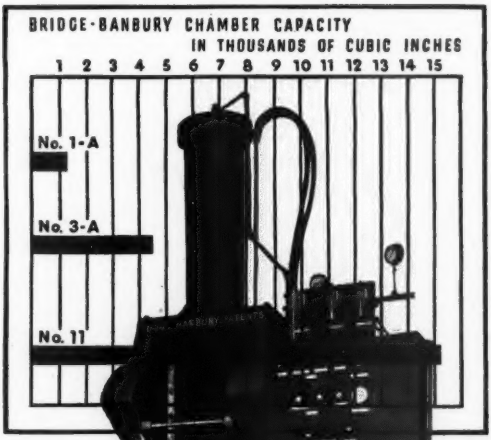
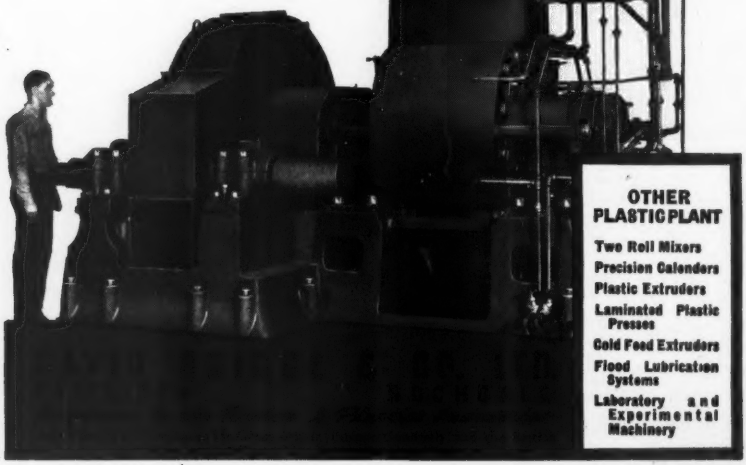
New Plastics

The number 11 Bridge - Banbury mixer with a chamber capacity of 15,000 cubic inches is THE machine for Large-Scale Precision mixing of plastics. This mixer is as efficient and simple to operate as the popular and widely used smaller models.





OTHER PLASTIC PLANT

- Two Roll Mixers
- Precision Calenders
- Plastic Extruders
- Laminated Plastic Presses
- Cold Feed Extruders
- Flood Lubrication Systems
- Laboratory and Experimental Machinery

filled with resin. The condition of the resin is of some interest, inasmuch as it contains a very large proportion of bubbles which are more or less of the same size. This would seem to indicate that the curing at this point was rapid, the resin having set before any bubbles had sufficient time to develop to a large size.

It is interesting to note that throughout the structure of this moulding the resin exhibits similar characteristics. There does not appear to be a great variation in the size of the bubbles, as was found in the previously examined mouldings, and it is probable that this indicates, to some extent, a more generally rapid curing of the mass as a whole. This being so, some measure of support is given to the previously expressed opinion that the quantity of available lignin in the coconut shell—being in a reactive condition—takes part in the reaction. This would result in a decrease of the curing time and at the same time produce the structure seen.

In view of this, it is the more surprising that such thorough impregnation of the filler particles takes place, as one would logically conclude that a rapid cure would cut down the available time for the resin to fill the structure of the particles, resulting in incomplete impregnation. However, the observed conditions show that impregnation is unusually complete and therefore it would appear that the effect of the presence of lignin is twofold. First, it accelerates the curing reaction ; secondly, in view of the incompleteness of impregnation it is probable that the viscosity of the reacting mass is somewhat lower than usual.

It has been established in other fields that the filling of fine structures by fluid media appears to be more greatly influenced by the surface tension of the medium than by its viscosity, and therefore this aspect of the problem should not be overlooked, but more definite conclusions cannot be formulated at the present time due to the lack of experimental data on this subject, and hence this suggestion can only be regarded as being conjecture. In any event, and whatever the basic

Fig. 334.—Coconut-shell filled moulding : transverse section. Mag. 140 diameters.

causes of the resultant phenomena, it has been established that the coconut-shell filler produces better mechanical and electrical properties than were originally expected of it.

Further study of Fig. 333 shows very clearly the manner in which the particle structure has withstood the disruptive forces encountered, for the walls of the cells in question show no sign of distortion despite the fact that the three channels shown form a structure which might be expected to collapse relatively easily. This demonstrates the extremely rigid nature of the wall. However, the assumptions regarding these thin-walled structures withstanding the moulding pressures must not be regarded as being conclusive, for in view of the aforementioned remarks relating to viscosity and surface tension, the possibility of circumstances being such that the cavities in the particle structure are filled with resin before collapse occurs must not be overlooked.

This could be possible by virtue of the rigidity of the cell walls being sufficient to avoid collapse before the units become filled with resin ; in this way there would be an equal pressure inside and outside the cavities and the cell walls would not collapse. Thus for example, Fig. 334 shows another transition particle, in

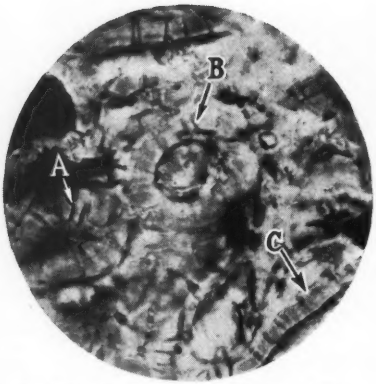


Fig. 335.—Coconut-shell filled moulding: transverse section showing pit channels. Mag. 750 diameters.

transverse section, in which both thick- and thin-walled cells are seen to exist. A group of thin-walled peripheral vessels are seen at " A," from which it will be noticed that the walls are very thin indeed when compared with those of the true shell elements, but in spite of this there are no signs of collapse. It is difficult to conceive of any cell with walls of these dimensions which would not collapse under moulding conditions, and therefore it appears to be more probable, in this case, that the structure is rapidly filled with resin, due to the extreme permeability of the mass of cells resulting from the presence of the network of pit channels. For even these thin-walled units may be seen to be liberally supplied with these structures. It will also be noticed that a number of the thicker-walled elements in this particle possess large internal cavities which are again completely filled, and the structure of the particle as a whole gives a good idea of the way in which the pit channels link up to form the continuous network.

The pit channels seem to be the key to the question of the impregnation of these coconut-shell particles, as without them the more central element in a particle could not be filled with resin. Thus, by way of interest, further examples of these structures are shown in Fig. 335 at a magnification of 750 diameters. This photograph shows units of true shell and transition elements, and is, therefore, useful for comparative purposes. Thus a true shell element is shown at " A," while a relatively thick-walled transition element is seen at " B." At " C " is shown a large thin-walled transition element which may be regarded as being a coir fibre unit, although in the fibre proper these elements with large bores are seldom met with. The shell element " A " shows clearly how the cavity is filled with resin, which is also seen in one of the pit channels, likewise all the cavities seen are filled in the same way, but in this particular portion it will be noted that the resin shows a remarkable freedom from bubbles—the type of structure previously encountered. Thus there are few, if any, bubbles evident, and the resin in the large cavities is in the form of clear masses.

It would appear to be a debatable point as to whether a resin matrix entirely free from bubbles is of great advantage when compared to a structure honeycombed with minute voids, for one is inclined to the assumption that in the latter case impact strength may be expected to be higher than would be the case with a bubble-free matrix; this being due to the shock-absorbing qualities of the porous structure. Whichever the case, it is certain that the porous structure would suffer from serious disadvantages from the point of view of electrical strength and possibly plastic yield; nevertheless, the possibility of producing greater impact strengths by deliberately fostering the production of a porous structure should not be entirely ignored, in cases where electrical strengths of a high order are not required.

However, at the same time it should be borne in mind that the size of void, in general, would be somewhat critical, for obviously a structure containing masses of bubbles of greatly differing sizes would not be as satisfactory in this respect as one wherein the voids were all more or less the same size. This being due to uneven stress distribution occuring in the former

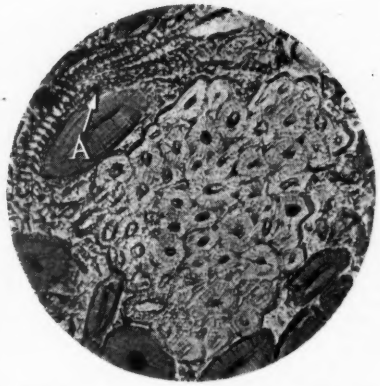


Fig. 336.—Coconut-shell filled moulding: transverse section showing coir fibre. Mag. 140 diameters.

instance, leads to localized high stress arrears and consequent earlier failure of the material. Anent this, therefore, it seems probable that a filler with low variability index and consistent particle shape would help in this direction, and as the coconut-shell flour material possesses these characteristics to a somewhat higher degree than usual, it is possible that a combination of porous resin matrix and low V.I. for the filler have a not inconsiderable influence in producing impact strength which is higher than expected.

We have up to the present discussed the structure of the coconut-shell filled moulding, and the probable influence of the filler on the properties of the finished article, and at the same time the structure has been shown to exhibit characteristic visual appearances which leave no room for doubt regarding the identification of the coconut-shell particle. During the examination it was shown that transition material was present, and in view of this it is inevitable that we should also find particles of true coir fibre present, as a few of these may always be found to be adhering to the surface of the shell proper. These particles of fibre also have a characteristic appearance under the microscope.

Fig. 336 shows a particle of coir fibre in transverse section at 140 diameters. Here, it will be noticed that the fibre elements are somewhat similar in general appearance to the surrounding shell elements, but in the case of the fibre the elements are considerably smaller and not so highly lignified, although the walls are thick: in general there should be no difficulty about their identification, which can be readily confirmed if a portion of fibre in longitudinal section (such as that shown at "A") can be located, when the lignification patterns may be readily distinguished. Thus, in the example shown, we see a group of fibre elements with typical spiral thickening not encountered in the elements of the shell proper. The percentage of these fibre particles is very small in a good quality flour, and their alternate influence may therefore be ignored, whether it be to produce an improved moulding or otherwise.

(To be continued.)

Brass Inserts in Plastics

Although notable improvements in the mechanical properties of plastic materials have been made in recent years, certain materials of the less-expensive kinds are still insufficiently strong for the purpose for which they are employed.

This defect, states the current Bulletin of the Copper Development Association, can, to a large extent, be overcome by the use of suitable metal reinforcement, for which brass is specially suitable. Particularly does this apply to threaded parts, for an otherwise satisfactory plastic article may be rendered useless by the premature failure of threads formed directly in the plastic, whereas for a trifling additional cost brass threaded inserts would give a reliable and strong fixing. Such inserts usually take the form of brass nuts which are embedded in the plastic. Leaded-brass is the most popular material for these nuts, as their small sizes makes material costs of less importance than machining costs, and their freedom from corrosion is also valuable.

The use of these brass threaded inserts has now become so general that efforts are being made to standardize them in the Nos. 2, 4 and 6 B.A. sizes, both with open ends and with the embedded ends closed with brass caps, to prevent the entry of the plastic during the moulding operation.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 600,904. Application date: 20.5.43. Accepted: 22.4.48.

Improvements in the Production of Vinyl Halide Resins. J. J. P. Staudinger and B. K. Kelly. To: The Distillers Co., Ltd.

Polymerization of vinyl halides and/or vinylidene halides in aqueous emulsion or dispersion in the presence of a saturated lower aliphatic alcohol (methanol) and crotonic acid, a peroxide catalyst and an unsaturated chlorinated hydrocarbon (trichlorethylene, etc.). The products so obtained are easier to plasticize.

B.P. 600,905. Application date: 20.5.43. Accepted: 22.4.48.

Improvements in or relating to Polymerization Reactions. J. J. P. Staudinger and M. D. Cooke. To: The Distillers Co., Ltd.

Polymerization of vinyl halides and/or vinylidene halides in the presence of crotonic acid.

B.P. 600,916. Application date: 3.8.44. Convention date (U.S.A.): 7.8.43. Accepted: 22.4.48.

Alkyl Ester Copolymers. E. L. Kropa. To: American Cyanamid Co.

Refers to copolymers of diallyl phthalate and diethyl fumarate.

B.P. 600,917. Application date: 5.9.44. Accepted: 22.4.48.

Emulsion Polymerization. E. L. Kropa. To: American Cyanamid Co.

Polymerization of a mixture consisting of an unsaturated alkyd resin and styrene.

B.P. 600,924. Application date: 22.12.44. Convention date (U.S.A.): 24.12.43. Accepted: 22.4.48.

Improvements relating to Resin Emulsions. To: Johnson and Johnson (Gt. Britain), Ltd.

Textile printing inks comprising a pigment containing emulsion having an aqueous continuous phase and a disperse phase of a normally solid polyvinyl acetate or polyvinyl butyral together with water insoluble plasticizer and a thickener for such emulsions.

B.P. 600,948. Application date: 30.7.45. Convention date (U.S.A.): 11.10.44. Accepted: 22.4.48.

Resin Bonded Moulded or Shaped Articles and their Preparation. M. E. Hughes. To: Shell Development Co.

B.P. 600,950. Application date: 20.5.43. (Divided out of 600,904.) Accepted: 22.4.48.

Improvements in the Production of Vinyl Halide Resins. J. J. P. Staudinger and B. K. Kelly. To: The Distillers Co., Ltd.

B.P. 600,961. Application date: 19.9.45. Convention date (U.S.A.): 20.9.44. Accepted: 23.4.48.

Improvements in or relating to the Impregnation of Wood with Urea Formaldehyde. To: E. I. Du Pont De Nemours and Co.

B.P. 600,999. Application date: 7.12.45. Accepted: 23.4.48.

Printed Sheet Materials. W. E. F. Gates. To: Imperial Chemical Industries, Ltd.

Printing of polythene sheets. The printing operation is carried out whilst the polythene is molten with a printing mixture which is capable of forming a solid solution with polythene. Cooling is carried out rapidly after printing.

B.P. 601,050. Application date: 21.4.44. (Divided out of 586,708.) Accepted: 26.4.48.

Process for the Lamination of Plastic Sheet Material. To: E. I. Du Pont De Nemours and Co.

Lamination of plastic sheets which do not usually adhere readily to each other, but one of which will adhere to glass by applying to one side of the sheet a water-insoluble plasticizer for the plastic sheet and subsequently a liquid polysilicic acid sol and a volatile solvent for both plasticizer and the acid sol, placing a sheet of a different plastic which readily adheres to glass, in contact with the coated side of the first sheet and uniting the whole structure by heat and pressure.

B.P. 601,075. Application date: 25.9.45. Convention date (U.S.A.): 14.9.44. Accepted: 27.4.48.

Improvements in or relating to the Preparation of Mono-Substituted Isomelamines. To: American Cyanamid Co.

B.P. 601,076. Application date: 26.9.45. Convention date (U.S.A.): 27.9.44. Accepted: 27.4.48.

Manufacture of Vinyl Cyanide. To: Imperial Chemical Industries, Ltd.

Cups and saucers fabricated by Synthena Ltd.

MODERN TABLEWARE in "Perspex" acrylic sheet satisfies aesthetic as well as practical requirements. It has an attractive finish and is available in a wide range of pleasing colours. This type of tableware has proved both serviceable and economical in use.

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P.302

IMPERIAL CHEMICAL INDUSTRIES LIMITED

moulded plastic panel for the H·M·V Model 1356 Radio Receiver made for E·M·I Suppliers Ltd. from phenol formaldehyde moulding material by . .

BRITISH MOULDED PLASTICS LTD
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BM117

THE MARK OF A NATIONAL PLASTICS COMPANY

Refers to the catalytic synthesis of vinyl cyanide from hydrogen cyanide and acetylene, using liquid-paste catalysts consisting of solutions of cuprous salts.

B.P. 601,101. Application date: 5.6.42. Accepted: 28.4.48.

Improvements in or relating to Synthetic Resins. T. Urbanski. To: Ministry of Supply.

B.P. 601,123. Application date: 16.3.45. Accepted: 28.4.48.

Improvements in the Production of Synthetic Linear Condensation Polymers. To: British Celanese.

Self condensation of beta-aminopropionic acids which are disubstituted on the alpha-carbon atom by organic radicals which do not interfere with amide formation.

B.P. 601,191. Application date: 30.10.45. Accepted: 29.4.48.

Improvements in the Polymerization of Vinyl Acetate in Emulsion. D. Cleverdon and J. J. P. Staudinger. To: The Distillers Co., Ltd.

B.P. 601,223. Application date: 9.10.44. Convention date (U.S.A.): 8.9.43. Accepted: 30.4.48.

Improvements in or relating to Polymerization of Butadiene-1, 3 Hydrocarbons and the polymerization of Mixtures of Copolymerizable Unsaturated Organic Compounds, at least one of which is a Butadiene-1, 3 Hydrocarbon in Aqueous Emulsion. C. F. Fryling. To: B. F. Goodrich Co.

B.P. 601,256. Application date: 5.6.45. Accepted: 3.5.48.

Improvements in or relating to the Welding together of Films or Sheets of Thermoplastic Material. G. Haim and H. P. Zade.

High-frequency welding of polythene films by interposing between the polythene films and the electrodes of a p.v.c. film applied by spraying, brushing, etc. The welding operation can be continuous when roller electrodes are employed.

B.P. 601,258. Application date: 18.6.45. Accepted: 3.5.48.

Improved Polymerization Products particularly for Use as Lubricating Oil Additives. To: Standard Oil Development Co.

B.P. 601,293. Application date: 22.11.45. Convention date (U.S.A.): 23.8.48. Accepted: 3.5.48.

Coagulation of Emulsion Polymere. To: Wingfoot Corporation.

B.P. 601,305. Application date: 28.12.43. Accepted: 4.5.48.

Improvements in or relating to Monofilament Synthetic Yarns, Strands or Strips and Fabrics Woven therefrom. To: The Firestone Tire and Rubber.

Monofilament polyvinylidene chloride upholstery yarn, strand or strip having one convex and one concave surface.

B.P. 601,308. Application date: 13.5.44. Convention date (U.S.A.): 9.7.43. Accepted: 4.5.48.

Mixed Aldehyde Condensation Products and Processes of Producing same. To American Cyanamid Co.

Condensation of resorcinol, formaldehyde and an incompletely polymerized melamine formaldehyde condensation product in which an alkali is added. The product so obtained is useful for laminating and bonding.

B.P. 601,384. Application date: 28.3.45. Convention date (U.S.A.): 11.2.44. Accepted: 5.5.48.

Improvements in and relating to Method of and Mould for making Integral Reed Plates and Reeds for Musical Instruments such as Harmonicas and Accordions. To: International Plastic Harmonica Corporation.

B.P. 601,390. Application date: 20.6.45. Accepted: 5.5.48.

Improvements in or relating to Emulsion Polymerization. To: Standard Oil Development Co.

Polymerization of diolefins (butadiene, isoprene, etc.) admixed with monolefins (acrylonitrile, methyl methacrylate, etc.) in the presence of morpholine or piperidine.

B.P. 601,413. Application date: 2.10.45. Convention date (France): 10.3.43. Accepted: 5.5.48.

Improvements relating to the Manufacture of Threads and Similar Articles from Polyvinyl Compounds. To: Société Rhodiaceta.

Manufacture of threads, filaments, etc., by spinning a material containing a polymerized vinyl compound and an incompletely condensed thermosetting resin and subjecting the product so obtained to a final heat treatment for condensation of the thermosetting resin.

B.P. 601,452. Application date: 6.2.45. Convention date (U.S.A.): 3.3.44. Accepted: 6.5.48.

Improvement in Vinyl Resin Suspensions. C. I. Spessard. To: Carbide and Carbon Chemicals Corporation.

B.P. 601,496. Application date: 3.10.45. Accepted: 6.5.48.

Improvements in or relating to Film Adhesives. A. M. Jamieson, E. E. Barton. To: Bakelite, Ltd.

Preparation of a film adhesive by compounding a polyvinyl acetal with a heat-hardenable phenol-aldehyde resin, forming the compound into a film and stretching the latter in one or two directions to effect molecular orientation. The film so obtained can be used for bonding metals to one another. The bond is stronger than the one obtained when using unoriented film.

B.P. 601,506. Application date: 17.10.45. Accepted: 6.5.48.

Acid Resistant Containers made from Synthetic-resin Mouldable Compositions. To: General Motors Corporation.

Acid resisting battery boxes made of a mouldable composition containing hydrolysed vegetable fibrous material (65-57 per cent. cellulose and 35-43 per cent. lignin) impregnated with a single-stage thermosetting resin.

B.P. 601,539. Application date: 25.9.45. Convention date (U.S.A.): 14.9.44. Accepted: 7.5.48.

Improvements in or relating to the Preparation of N, –disubstituted Melamines To: American Cyanamid Co.

B.P. 601,568. Application date: 7.2.45. Convention date (U.S.A.): 11.12.44. Accepted: 7.5.48.

Improvements in and relating to Polymers of Vinyl Compounds and their Preparation. To: The British Thomson Houston Co., Ltd.

Refers to polymers of vinyl-substituted dibenzofurans.

B.P. 601,587. Application date: 28.5.43. Convention date (U.S.A.): 14.8.42. Accepted: 10.5.48.

An improved Process for the Manufacture of Rubber-like Polymeric Materials. To: Standard Oil Development Co.

B.P. 601,604. Application date: 19.3.45. Convention date (U.S.A.): 30.5.44. Accepted: 10.5.48.

Improvements in Production of Polyoxypropylene Compounds. H. R. Fife and F. H. Roberts. To: Carbide and Carbon Chemicals Corporation.

B.P. 601,646. Application date: 5.12.45. Accepted: 10.5.48.

Improvements in or relating to Braces for Personal Wear. J. Veit and J. F. Kenure.

B.P. 601,647. Application date: 5.12.45. Accepted: 10.5.48.

Improvements in or relating to Braces for Personal Wear. J. Veit and J. F. Kenure.

B.P. 601,662. Application date: 18.5.44. Convention date (U.S.A.): 20.9.41. Accepted: 11.5.48.

Weather Sealing Methods and Means. R. L. Davison.

B.P. 601,683. Application date: 5.4.45. Accepted: 11.5.48.

Improvements in or relating to the Control of Frothing or Foaming in Liquids. W. G. Daroux. To: British Resin Products, Ltd.

B.P. 601,694. Application date: 28.6.45. Convention date (France): 25.5.43. Accepted: 11.5.48.

New Cellulose Derivatives and their Process of Preparation. To: Comptoir des Textiles Artificiels S.A.R.L.

Manufacture of cellulose derivatives by adding a monomeric trimethylol phenol to an aqueous dispersion or solution of cellulosic material containing free hydroxyl groups, the trimethylol phenol forming bridge linkages between the cellulose molecular chains, separating the cellulosic material so treated and subjecting it to heat to effect polymerization.

B.P. 601,695. Application date: 28.6.45. Convention date (France): 25.5.43. Accepted: 11.5.48.

Process for the Production of Artificial Filaments, Fibres and Films of Low Swelling Characteristics: To: Comptoir des Textiles Artificiels S.A.R.L.

B.P. 601,713. Application date: 15.3.46. Accepted: 11.5.48.

The Coating of Sheet Materials. W. E. F. Gates. To: Imperial Chemical Industries, Ltd.

Relates to the coating of sheet materials with polythene (example quoted: Kraft-paper, cardboard, cellophane, metal).

B.P. 601,715. Application date: 17.5.46. Accepted: 11.5.48.

The Coating of Sheet Materials. W. E. F. Gates. To: Imperial Chemical Industries, Ltd. Similar to B.P. 601,713.

B.P. 601,762. Application date: 11.10.45. Convention date (U.S.A.): 12.7.45. Accepted: 12.5.48.

Compositions from Vinylidene Chloride Copolymers. To: Wingfoot Corporation.

Coating compositions prepared from vinylidene chloride copolymers by blending 10-90 parts of benzene-soluble copolymer of vinyl chloride and 40-80 vinylidene chlo-

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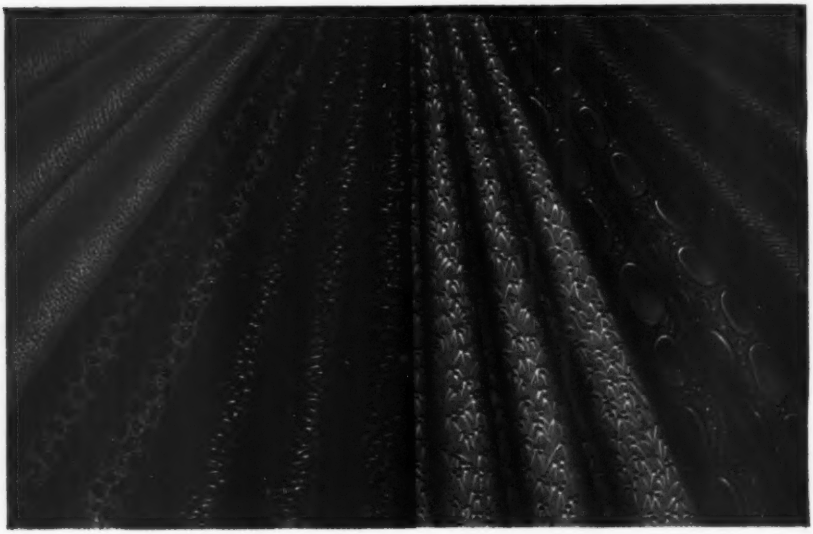

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ride and 90-10 parts of a chlorinated polynuclear hydrocarbon containing at least 35 per cent. chlorine.

B.P. 601,763. Application date: 11.10.45. Convention date (U.S.A.): 19.7.45. Accepted: 12.5.48.

Synthetic Rubber. To Wingfoot Corporation.

Refers to copolymers of butadiene, 1-3, and styrene or acrylonitrile.

B.P. 601,796. Application date: 23.11.45. Convention date (U.S.A.): 9.12.44. Accepted: 12.5.48.

Apparatus and Process for Pressing Plastic Sheeting: To: Bakelite Corporation.

Refers to equipment for continuous planishing, laminating and embossing of thermoplastic sheets.

B.P. 601,807. Application date: 10.12.45. Convention date (U.S.A.): 9.12.44. Accepted: 12.5.48.

Manufacture of Vinyl Esters and Polymers and Interpolymers derived therefrom. To: Imperial Chemical Industries, Ltd.

Refers to fluorine containing vinyl esters and their polymers and interpolymers.

B.P. 601,819. Application date: 3.10.45. Accepted: 13.5.48.

Manufacture of a Synthetic Resin. F. M. Gargill.

Thermoplastic resin produced by treating a mixture of thiocarbamide and a soluble thiocyanate, dicyandiamide or hexamethylene tetramine with a soluble sulphate and the resulting compound with copper sulphate, separating and cooling the lower liquid phase of the mixture.

B.P. 601,874. Application date: 9.10.45. Convention date (U.S.A.): 21.9.44. Accepted: 13.5.48.

Improvements in and relating to Bag with extensile Sealed Liner. To: St. Regis Paper Company.

B.P. 601,896. Application date: 10.10.45. Convention date (U.S.A.): 12.10.44. Accepted: 13.5.48.

Improvements in Cellulose Ester Products. To: British Celanese, Ltd.

Improving the resistance of shaped cellulose ester articles to actinic light by applying to the surface of the article a composition containing phenyl salicylate.

B.P. 601,900. Application date: 26.10.45. Accepted: 13.5.48.

Improvements in or relating to the Manufacture of 2-Ethyl-n-hexanol and alpha-Ethyl Caproic Acid, the Esters thereof and Plasticized Compositions containing said Esters. B. Duval and K. H. W. Tuerck. To: The Distillers Co., Ltd.

B.P. 601,901. Application date: 26.10.45. Accepted: 13.5.48.

Improvements in or relating to the Manufacture of Ethylcaproic Acid, Esters thereof and Compositions containing said Esters. B. Duval and K. H. W. Tuerck. To: The Distillers Co., Ltd.

Relates to the production of alpha-ethyl caproic acid and to the use of esters thereof in polyvinyl chloride compositions.

B.P. 601,904. Application date: 1.7.43. Accepted: 14.5.48.

Production and Manufacture of Resinous Products from Phenolic Oils. G. S. Pound and S. R. M. Ellis. To: Low Temperature Carbonisation, Ltd.

B.P. 601,926. Application date: 12.11.45. Convention date (U.S.A.): 17.11.44. Accepted: 14.5.48.

Improvements in or relating to the Production of Moistureproof Sheet or Film. To: British Cellophane, Ltd.

Refers to the employment of an anchoring layer between an organic, non-fibrous, water sensitive base sheet or film and a moisture-proof surface coating. The anchoring layer consists of a hardened and insoluble melamine-formaldehyde monohydric alcohol resin partly condensed by heat on the base material.

B.P. 601,958. Application date: 26.4.44. Accepted: 18.5.48.

Improvements in the Manufacture of Composite Materials or Articles. A. C. Brown and T. H. Angel. To: Venesta, Ltd.

Laminated structures in which the component parts are adhesively united by means of synthetic resins of the phenol-aldehyde type.

B.P. 601,967. Application date: 23.11.44. Convention date (U.S.A.): 24.11.43. Accepted: 18.5.48.

Improvements in or relating to the Production of Melamine. To: American Cyanamid Co.

Preparation of melamine by heating cyanourea at a temperature of 200 degrees C. in the presence of ammonia.

B.P. 601,983. Application date: 3.5.45. Convention date (U.S.A.): 6.5.44. Accepted: 18.5.48.

Manufacture of Aminotriazine-Aldehyde reaction Products. To: Monsanto Chemical Co.

QUALITY CONTROL IN PLASTIC MOULDING

(Continued from page 550.)

obvious reasons, it was regarded as highly undesirable to move all the components from each machine into a central inspection department, lest products from one moulding machine became accidentally mixed with those from the second machine. It was, indeed, essential to keep the two sets of mouldings isolated and completely segregated from each other.

The fourth preliminary factor to be resolved was in connection with the drawing limits required to be maintained on the finished articles. Before any production was embarked upon careful tests were made from each mould to determine whether or not they were capable of producing consistently parts to the requisite degree of accuracy.

Having determined all this information with reliability, the next step to be taken was to ascertain the control limits for the control charts. The general methods employed for obtaining this data were similar to those required for the simple type of control charts referred to in detailed fashion in several preceding instalments in this series.

(To be continued.)

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Leaves from a Moulder's Notebook

This is the twenty-second in a series of notes by the B.I.P. Development Department on the problems of the moulder and designer. Nos. 1—12 in this series are now available in booklet form and B.I.P. will be pleased to send a copy of this and subsequent notes on request. Comments and enquiries are welcome.

Frictional Heating in Transfer Moulding

A large proportion of the transfer force of transfer moulding is changed to frictional heat in forcing the charge through the feeds. The heat is absorbed by the charge in transit and, although a most useful servant, it can become a bad master.

Due to the low heat conductivity of the charge, the friction heat is not absorbed evenly; most of it is retained by the outside skin or layer and only a small proportion is passed to the 'core' of the charge whilst in the feeds. Consequently a stage can be reached when the outside skin will begin to harden and cure while the 'core' is still below the heat of polymerization. The charge will reach the mould in the form of a worm, the skin of which is hardened too much to permit of properly 'joining up'; a moulding full of distinct flow marks is the first result.

The control of frictional heat lies in the use of short feeds coupled with a careful marrying of feed cross section to the lowest pressure which can be used. This is a policy of self defence; research may teach us how to use the heat of friction to such effect that we may even court its company.

A formula to calculate the rise in temperature of a charge due to frictional heat, assuming that all the transfer force is transformed to heat and absorbed uniformly by the charge, is as follows :—

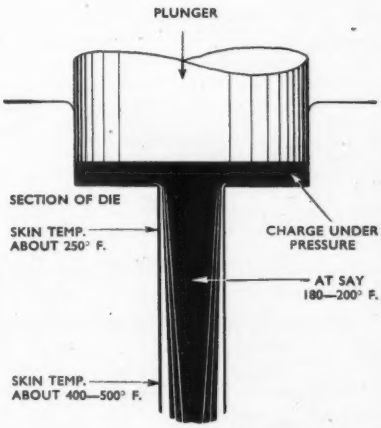
$$\frac{11TS}{W} \text{ °F.}$$

Where T is transfer pressure in tons

S is the stroke in inches

W is the weight of the charge in ounces

This assumes specific heat of .35 and ignores the heat absorbed by the tool from the charge.



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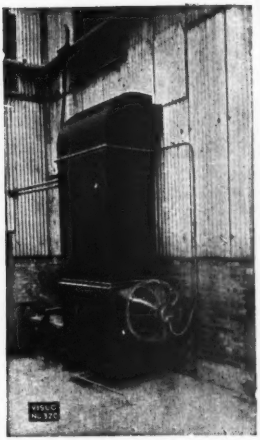

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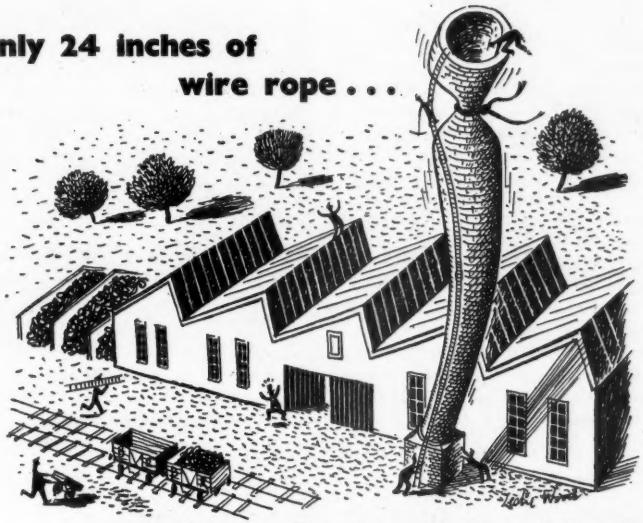

but it nearly strangled production

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Here it is again—the old, old story of the wood being obscured by the trees ! What is Management's first line of attack in the battle against these 'blind spots'? Simply to call in the Ministry's Fuel Engineer. Here's a man eager to help and trained to spot any weak link which may be hindering your production drive. His services are free. Why not give him a ring today. It's so much better to be safe than sorry.

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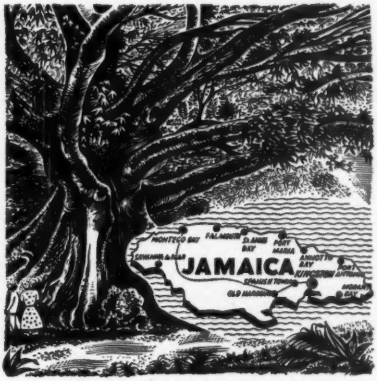

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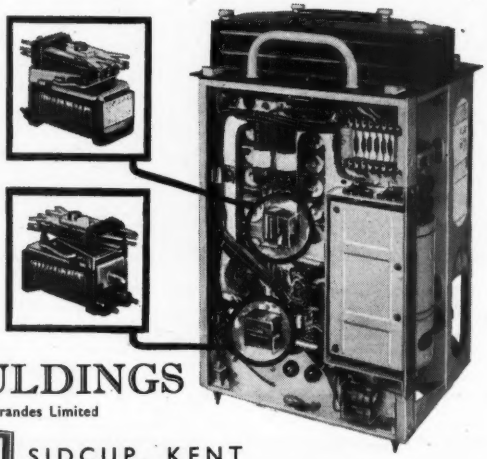

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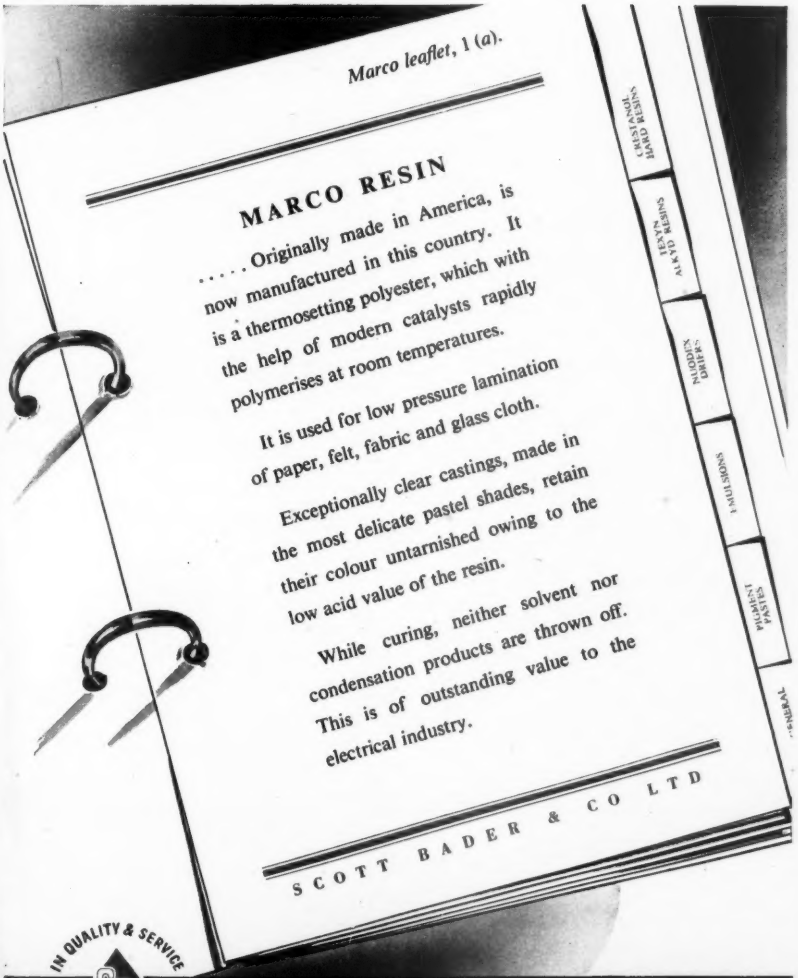
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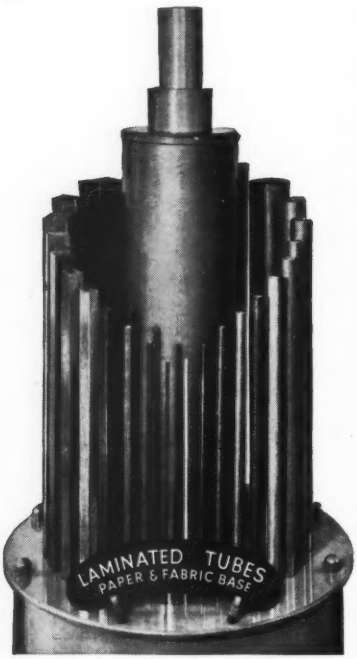

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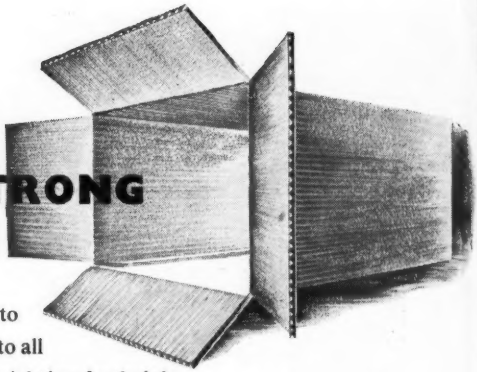

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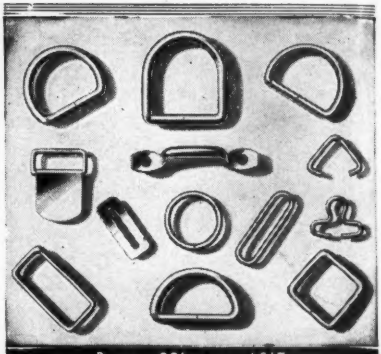

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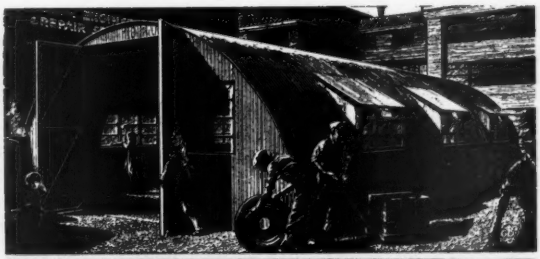

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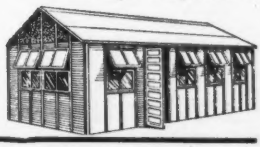

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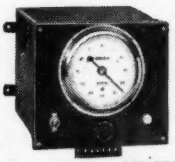

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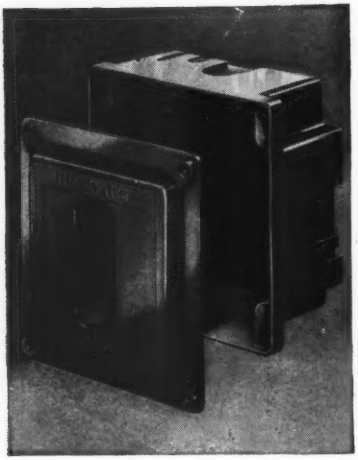

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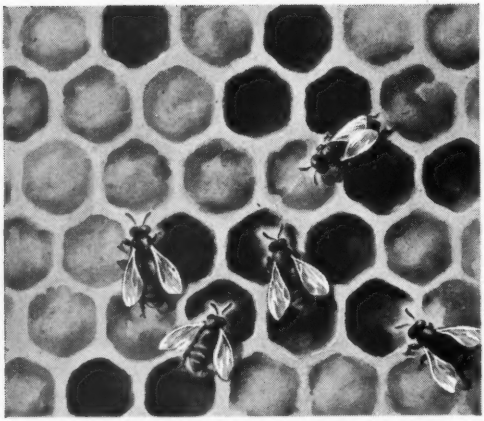

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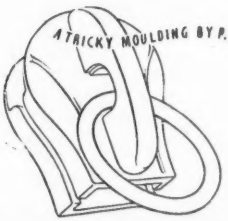

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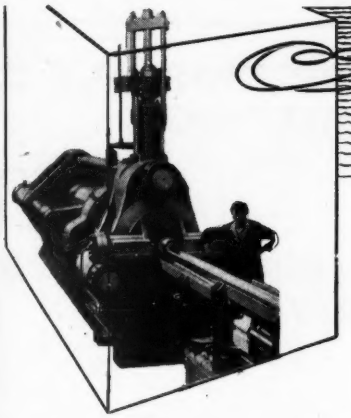

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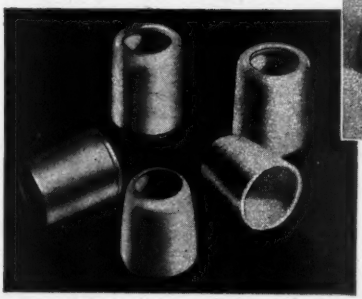

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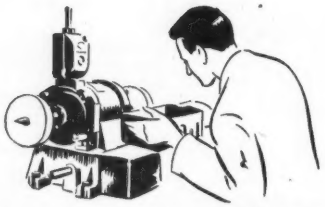

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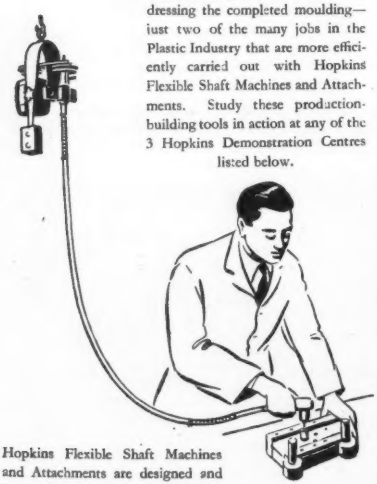

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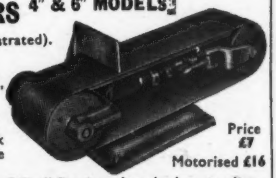

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AGENCIES WANTED

Small limited company would undertake sole agency for actual manufacturers of coated fabrics, plastic sheet, etc. Manchester and district and export. Interview arranged through Box 6264, care of "Plastics." 138-499

Agency required by firm well established in leather manufacturing industry in State of New South Wales, Australia, for P.V.C. sheeting. Max Garrett, Richmond House, 154 Castlereagh Street, Sydney, Australia. 137-30

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AND MACHINERY,
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Phone, Temple Bar 7471 (four lines).
zzz-203

BUSINESSES, PREMISES, OFFICES, ETC.

For sale, small limited company of injection moulders. low price for quick sale. Particulars, Box 5891, care of "Plastics." 137-x6594

DESIGN AND DRAWING

Product design and drawing capacity, styling, development and working drawings. H. Woodhouse-Midgley, 34 Kildare Terrace, Bayswater, London, W.2. Bayswater 6080. 138-253

Design and drawing capacity for plastic moulds (injection, compression, transfer), and component design development. Graystone Designs, 35 Winchester Road, Hampstead, N.W.3. Phone, Pri 7420. zzz-237

M.M. Designs. Designers and consultants, 16 years' experience of mould and product design offered to our clients. We can arrange manufacture, too, if desired. Office, 136 Spencer Place, Leeds, 7. 139-438

MACHINERY, TOOLS AND PLANT

Alternators, Diesel sets, electric motors, switch gear, transmission equipment, fluorescent lighting and industrial fittings, ex stock. Keen prices. Contact G. L. Murphy, Ltd., Menston, near Leeds. zzz-210

Shaw hydraulic accumulator, 120 tons cast iron weight loaded type with three throw pumps, not A.C. 415/3/50, latest design, as new.
Two Shaw hydraulic presses, 60 tons, four columns, platens 3 ft. 6 ins. by 4 ft., daylight 6 ft. 6 ins., as new.
Ingersoll Rand horizontal compressor, 100 cubic ft. per min., mot A.C. 415/3/50.
W. Urquhart, 1023-1027 Garratt Lane, S.W.17. Bal 3351. 138-06434

Engraved rollers for embossing and printing P.V.C. T. G. Martin and Co., Old Colony House, Ridgefield, Manchester, 2. Blackfriars 3022. 138-x3241

Twelve plating vat rumblers by Cruickshank, 18-in. diam. by 21 in. deep, belt driven, £25 each. Thompson and Son (Millwall), Ltd., Cuba Street, London, E.14. zzz-234

Injection Moulding Machines for sale:
One T.M.A. S.H.6 6-oz. capacity machine, priec £1,800.
One E.M.B. 4-oz. capacity machine, complete with compressor motor, etc., price £1,600. Box 5868, care of "Plastics." 137-444

One Rediffon R.H.12 radio heater for sale, as new, complete with process timer, small heating chamber H.C.9 and complete set of spare valves, Box 6257, care of "Plastics." zzz-240

Machinery, Tools and Plant (contd.)

Full steam in five minutes with B. and A. Electrode Boilers, used by British industries for 20 years. No boiler-house, no flue, no attendant needed. The most compact and convenient steam raisers available. Can go beside machines using the steam. Write for leaflet 118. Bastian and Allen, Ltd., 11 Bedford Square, W.C.1. 139-502

Ten moulds for tableware and fancy goods for sale, suitable for 1-3-oz. injection moulding machines; also three toy moulds and bolster for Westminster or alike. All in very good condition at a moderate price. Can be inspected in London. Write Box 2659, care of "Plastics." 137-18

Injection moulding machine for sale, capacity 1½ oz., complete with compressor, receiver and motor, little used, in excellent condition, very reasonable price. Details, write to Box 6261, care of "Plastics." 137-16

For hire, 4-oz. injection moulding machine, modern type. Box 6263, care of "Plastics." 137-14

For sale, one dual unit, 50-ton downstroke compression press by Finney, practically unused, £650. Box 6267, care of "Plastics." 137-10

Shaw 1-in. extruder, as new £380 or best offer. 41 Marshgate Lane, E.15. Maryland 2804. 137-2

Funditor transfer marking machine for disposal suit resistance and electric bulb manufacturer. 555 Becontree Avenue, Dagenham, Essex. 137-x7208

One second-hand Henley 1-in. lead extrusion machine, comprising:
(1) Type 1-in. extrusion machine.
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(3) Ward Leonard generating set, complete with contactor panel and starter.
(4) Capacitors for the above generator.
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(6) Air compressor and receiver complete with motor.
(7) Automatic tubular furnace complete with pig magazine.
All the above are fitted with electrical equipment suitable for 200 volt, 2 phase, 50 cycle A.C. supply. The feed and take-up stands are not included. Box 5865, care of "Plastics." 137-29

Machinery, Tools and Plant Wanted

Wanted, moulds, new or second-hand, for all household electrical goods, moulds for plugs, switches, etc. Other moulds also considered. Reply to Box 6256, care of "Plastics." 137-20

Small hand injection moulding machine wanted. Box 6272, care of "Plastics." 137-31

PRODUCTION CAPACITY AVAILABLE AND WANTED

Repetition in Ebonite, Erinoid, etc. Capstan lathe work. Mansell, Temple Street, Rugby. 137-3687

Kingston Plastics, Ltd., Unity Works, Union Street, Kingston-on-Thames, have all the facilities for cleansing, sorting, grinding, kibbing and reprocessing of thermoplastic materials. Phone, Kingston 8405. 138-4012

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Hand colouring on any plastic smallwares expertly carried out with taste. Long runs only accepted.
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Good deliveries. Presswork up to 40 tons, tools, fixtures, jigs. All sorts light engineering, commercial plating, galvanizing; also woodwork, assembling, etc.; mass production. Universal Components, Ltd., 19 Sunderland Terrace, Bayswater, W.2. Bayswater 6776. 137-6444

P.V.C. silk screen printing. Table cloths, curtains, nursery patterns, etc. Capacity available for quantity runs. Quality work. Daily deliveries. Guaranteed adhesion and fastness of colour. Davis (Patents), Ltd., 18 Phipp Street, London, E.C.3. 137-6445

Dohm, Ltd., pulverize raw materials everywhere. 167 Victoria Street, London, S.W.1. zzz-224

Work wanted, Spur gear cutting, planing, shaping, centre lathe work, machine construction. S. J. Clarke and Sons (Engineers), Ltd., 54A St. Paul's Street, London, N.1. Phone, Canonbury 2260. 137-322

Injection moulding specialists have moulding capacity up to 4 oz. Consultants on all injection moulding problems. Please send inquiries to Box 5328, care of "Plastics." zzz-236

Production Capacity Available and Wanted (contd.)

Injection moulding capacity available on 3-oz. injection moulding machine for short and long runs. Box 5327, care of "Plastics." zzz-235

Small turned parts, including inserts, etc., of all types for the plastic trade supplied cheaply, accurately and rapidly. Only modern Swiss-type automatics used, ensuring first-class quality and finish. Quotations by return. Bristol Repetition, Ltd., Sales 2B, Portishead, Bristol. 138-366

Compression moulding capacity available. Short or long runs, 75-ton presses. J. H. Perry (Plastics), Annesley, Woodhouse, Notts. Phone, East Kirkby 2151. 140-368

Perspex. Will fabricators submit samples and quotations of any snappy made-up articles in clear Perspex to firm having several tons of ⅛-in. by 5/32-in. material available which they wish to have made up into saleable lines for home and export markets. S. G. Young, 154-6 Blackfriars Road, London, S.E.1. 137-x5024

Multi-daylight press capacity wanted for pressing sheets at least 1 ft. square. Larger platen area could also be utilized. Large contract available and manufacturers must be prepared to modify their presses for water cooling. Box 5845, care of "Plastics." 137-435

Plating on plastics. Silver, chrome, nickel, copper, by the non-conductive specialists. Atom Plating and Polishing Co., Ltd., 176 Albion Road, Stoke Newington, N.16. Phone, Clissold 4775. 138-437

P.V.C. flanged tubes for more efficient and more economical production of inflatable toys, etc. Full details and prices on application to Modo, Ltd., 1007 Argyle Street, Glasgow. 137-439

Engraving of perspex nameplates, etc., capacity available, own or customer's materials. Box 6269, care of "Plastics." 137-9

Capacity required for development of moulded products with medium size press, if successful, production orders would follow. Write Box 6266, care of "Plastics." 137-12

Work wanted, facilities available for the deflashing, polishing and assembly of small parts, metal and plastic; small firm in Scotland. Box 6247, care of "Plastics." 137-27

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100,000 sheets celluloid, 1-ft. and 1-ft. 4-in. Carbot, Ltd., 201-205 Long Lane, London, S.E.1. Phone, Hop 1762. 137-x5077

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Raw Material Available and Wanted (contd.)

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Perspex. R. Denny and Co. Stocks available for immediate delivery. Sheet or cut to specification. Inquiries invited for display stands, panels, windows, windscreens, etc.; quotations by return. 271 High Street, Acton, London, W.3. Phone, Acorn 5777. 141-429

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ANY QUANTITY FOR CASH.
SEND SAMPLE AND DETAILS.
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37 FARRINGDON STREET, E.C.4.
Central 5947 141-432

Polystyrene wanted (virgin), light blue, light pink; good price paid. Write Box 5846, care of "Plastics." 137-434

Polythene Powder (white) for disposal, any mesh, well below maker's price, sample sent upon request. Box 5835, care of "Plastics." 138-436

P.V.C. compounds, recompounded material free from all impurities, large quantities available in granular and strip form ready for use, wide variety of colours, available from 6d. a lb. Apply Box 5859, care of "Plastics." 137-442

2,000 SHEETS CRYSTAL-CLEAR 40-THOU. ACETATE.
Size 56 ins. by 25 ins.
Weight per sheet 2 lb. 14 ozs
LOW PRICE FOR COMPLETE CLEARANCE
ALSO 1 TON 3-MM.
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37 FARRINGDON STREET, LONDON, E.C.4
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An entirely new embossed sheeting, ideal for upholstery and fancy leather goods, unbacked, extremely strong, tough and pliable, excellent graining, antique, morocco, calf, pigskin, etc., all standard colours, 48-in. width. Almex, Ltd., Exchange Buildings, Stephenson Place, Birmingham, 2. Midland 0682.
Cuprex, Ltd., 120 Moorgate, London, E.C.2. Metro 9641. zzz-223

Ebonite and bakelite always in stock. Phone, Archway 3654. A. E. Goodeye, Ltd., 188a Seven Sisters Road, London, N.7. 139-4965

Raw Material Available and Wanted (contd.)

Buna-plast, a blending of synthetic rubber and P.V.C. specially processed for manufacturing leather substitute; this material is far superior to plasticized P.V.C., inquiries welcomed. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-230

P.V.C. calendering compound in a range of opaque colours. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-229

Polystyrene moulding scrap urgently required, state amount available and send small sample. Box 3185, care of "Plastics." zzz-228

1st quality virgin cellulose acetate moulding powder available. Box 3184, care of "Plastics." zzz-227

Polythene moulding powder (reconstituted) in black natural and a variety of colours. Dohm, Ltd., 167 Victoria Street, London S.W.1. zzz-226

Metal powders and oxides. Quotations and samples on application. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-225

P.V.C. For sale, clean sheeting cuttings and cable strippings. John Castle and Co., Ltd., 18a Newport Street, Lambeth, S.E.11. 137-375

Perspex. For sale, about 5 tons clean, clear scrap and small offcuts. John Castle and Co., Ltd., 18a Newport Street, Lambeth, S.E.11. 137-374

Polystyrene scrap or surplus stocks of virgin material wanted. Box P.35, Nevin D. Hirst (Advertising), Ltd., 23 Mount Preston, Leeds, 2. 137-0311

Perspex acrylic sheet.
Large range of colours from 1-16 in. to ½ in. Large stocks, good delivery.
J. H. Berry (Plastics), Annesley Woodhouse, Notts. Phone, East Kirkby 2151. 140-569

For sale. New Perspex sheeting, thickness from ⅛ in. to ¼ in. in clear and all colours Offered below cost price. Box 6248, care of "Plastics." 137-26

Cellulose acetate injection moulding powder scrap required, clean colours essential, stalks preferred. Box 6260, care of "Plastics." 137-17

For sale. Quantities of phenolic moulding powder, black and walnut at 10d. per lb. Pink, blue and black cellulose acetate at 2s. 9d. per lb. Polythene in various colours at 3s. lb. Box 6268, care of "Plastics." 137-11

Perspex sheeting ⅛ in. for disposal under cost. Box 6134, care of "Plastics." 137-x7443

About 7 cwts. of P.V.C. thread, blue, brown and black on wood reels. John Walton and Co. (Castleside), Ltd., Metalex Works, Gt. Cambridge Road, Enfield, Middx. 139-500

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I.C.I. Perspex dyes and solvents for disposal at less than cost. Box 6251, care of "Plastics." 139-498

Wanted urgently, clear transparent cellulose acetate and Perspex scrap. Offers to Box 6250, care of "Plastics." 137-25

Flat Perspex sheets, clear or 16 colours, 54 ins. by 48 ins., or sizes cut to shape; corrugated Perspex roof lights, aluminium alloy and plastic sheeting and mouldings. Henry Moat and Son, Ltd., Atom Works, Newcastle, 1. 137-7

Scrap. Why not let a well-established firm quote you for cellulose acetate, polystyrene and other thermoplastic offcuts and scrap? Having best use for these materials, highest prices can be paid. Quotations on receipt of representative samples to M. H. Grist (Plastics), Ltd., 82-84 Brighton Road, Surbiton, Surrey. Phone, Elmbridge 4214. 137-28

Raw Material Available and Wanted (contd.)

Perspex tubing. We can now supply welded Perspex tubing from ¼ bore upwards. Inquiries invited. Evolite Plastics, Ltd., 325 Latimer Road, W.10. Phone, Lad 1879. 138-4011

D. H. Ridout and Son, Ltd., Reg. Office, 12 Stedman Road, Southbourne, Bournemouth. Phone, Southbourne 505.
Official stockists for I.C.I. acrylic Perspex, crystal and coloured, and "Crinothene" sheeting in all shades.
Offer acetate and celluloid transparent sheeting from 2s. per lb.
Bakelite laminated sheeting from 1s. 10d. per lb.
Coloured and clear Perspex off-cuts at 1s. 3d. to 2s. per lb. according to gauge and quantity required.
All types of plastic tubes and rod from 4d. per foot.
1¼-in. ribbed plastic belting at 6d. per yard.
Perspex No. 6 and No. 2 quick-drying cements and polishes.
Special offer of 1-oz. and ½-oz. amber bottles with plastic screw stoppers at 15s. per gross.
Send for new stock list which contains numerous interesting items to opticians and manufacturers of finished plastic goods.
Surplus stocks purchased.
D. H. Ridout and Son, Ltd., Stedman Road, Southbourne, Bournemouth. 137-1

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 50, inclusive, or a woman between the ages of 18 and 40, inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

Draughtsman (senior), jig and tool, for interesting post with electrical and mechanical engineers, S.W. London area, must have served recognized apprenticeship and be conversant with press tools, plastic moulds, hydraulics and general tooling. Higher National education essential, some electrical knowledge preferred. Salary up to £450 per annum, according to age and experience. Write full particulars to Box 5848, care of "Plastics." 138-433

A number of chemists and physicists required for a new research station in Essex. Applicants should have a good degree in chemistry or physics with preferably a few years' experience in industrial research or development on electronics; housing accommodation will be provided for the right type of keen and ambitious workers, salary of £500-£700 per annum. Apply, stating age, qualifications and experience, to Box 5867, care of "Plastics." 137-443

A firm of chemical manufacturers in Leeds have a vacancy for an organic chemist with experience of synthetic resins. Salary according to age and qualifications; superannuation scheme in operation. Box 5869, care of "Plastics." 137-445

Toolmaker required for plastic mould work, experience essential. First-class craftsmen only need apply. Send full details. "Seaforth," Watchett Works, Oakhurst Road, Southend-on-Sea. 137-446

Salesman required by manufacturers of thermo plastic raw materials and moulding powders, previous experience required, good prospects. Box 6255, care of "Plastics." 137-21

Senior draughtsman-designer required for the development department of a tyre and general rubber works in East Midlands; only men with good general experience and the highest qualifications need apply; excellent salary and prospects. Box 6254, care of "Plastics." 137-22

A leading plastics moulding company require representative or agent with knowledge of injection and compression methods, for Manchester and North Midlands. Box 6252, care of "Plastics." 137-24

Chemist with Honours Degree or equivalent is required for newly established development department of firm in North of England; experience in the coating of cloth with rubber or plastics is desirable but not necessary; a salary fully in accord with age and experience is available for the right man. Apply by letter giving particulars of age and qualifications to Box 6249, care of "Plastics." All responsible employees of the advertiser have been informed of this advertisement. 138-497

Situations Vacant (contd.)

A first-class opportunity. A progressive industrial group requires manager for an old-established business in Birmingham manufacturing insulating material in plastic mouldings, mica and micanite. Removal to larger premises and arrangements for improved production are in progress. This is an opportunity for a man of personality and administrative abiltiy. Sales and works experience essential. Remuneration would be related to results. Applications giving age and experience, and an indication of salary expected to Box 6265, care of "Plastics." 137-13

Wanted for our London office, whole-time technical and sales representative, with thorough knowledge of all the major branches of the plastics industry. Only capable and really experienced men need apply to Francis Shaw and Co., Ltd., Corbett Street, Manchester, 11. 137-3

AN AUSTRALIAN PLASTICS COMPANY has vacancies for a number of thoroughly experienced personnel in positions offering very good prospects for men desirous of immigrating to Australia.

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A Representative of the Company will visit England early November to interview applicants. Interviews will be invited only from those written applications which give the fullest possible details, both personal and in relation to experience.

The Company will materially assist in the immigration arrangements of selected applicants. Salaries will be discussed at the interview.

Apply to:—A.P.I., COMMERCIAL BANK OF AUSTRALIA, LTD., 12 OLD JEWRY, LONDON, E.C.2. 138-501

Organic chemist, aged 20-25, with University degree or equivalent qualifications, required for work on rubber modifications, etc. No previous experience necessary in this field. Salary according to qualifications and experience. Minimum £425 plus cost-of-living bonus. Please apply to the Technical Director, B.B. Chemical Co., Ltd., Ulverscroft Road, Leicester. 137-4

Technologist, with good personality and presence, aged about 30, required for senior position in the rubber adhesives development laboratory, having Science Degree or equivalent qualification with practical experience in rubber or related field of work. Some knowledge of engineering would be an advantage. Salary according to qualifications and experience. Minimum £550 per annum plus cost-of-living bonus. Please apply to the Technical Director, B.B. Chemical Co., Ltd., Ulverscroft Road, Leicester. 137-5

Perspex displays for advertising. Man required with all-round knowledge of machining and finishing, permanency. Full details to Priestley Studios, Ltd., Commercial Road, Gloucester. 137-6

Sales office assistant (male), capable of dealing with correspondence and general internal sales matters, experience in plastics preferable but not essential. The appointment offers good prospects. Write stating full details of experience and salary required to, Fraser and Glass, Ltd., Woodside Lane, North Finchley, London, N.12. 137-8

Foreman required with technical and practical knowledge of extrusion. Apply, with full details of previous experience, Box 5871, care of "Plastics." 137-32

SITUATIONS WANTED

Man, 28, at present employed by large Toronto plant in Canada, where 13 years' practical experience and one year executive can be used to advantage; design, manufacture and use of all modern methods of moulding, including manipulation of sheet, approximately 11 years toolroom and two years design. If necessary will return to England by end of year. Box 5480, care of "Plastics." 137-x5351

Foreman 39, moulding dept., desires change. 21 years' experience in trade, S. England or abroad preferred. Box 6242, care of "Plastics." 137-x7748

Foreman moulder, 10 years' experience compression and injection, good refs., home or abroad. C. Peet, 20 Victoria Road, Fairfield, Stockton-on-Tees. 137-x7253

Situations Wanted (contd.)

Company director, 25 years' experience plastics, responsible for many new P.V.C. developments, seeks similar appointment with enterprising concern. R. W. Bennett, Garden Flat, 53 Sutherland Avenue, W.9. 137-x7119

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Factory time recorders. Service rental. Phone, Hop 2239. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 137-3686

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Waterproof inks for plastics in all colours for spray and hand brush. Free samples from Lakeland Ink Co., 98 Ocean Road, Barrow-in-Furness. 137-x4383

Monomarks. Permanent London address. Letters redirected, 5s. p.a. Write, Monomarks, BCM/MONO76, W.C.1. 140-373

P.V.C. flanged tubes for more efficient and more economical production of inflatable toys, etc. Full details and prices on application to Modo, Ltd., 1007 Argyle Street, Glasgow. 137-449

Packing cases and boxes for all purposes. F. Rawle and Co., Ltd., 71 Kensington Avenue, London, E.12. Phone, Grangewood 2003. 147-441

Huts, Nissen type, reconditioned, 24-ft. span and 16-ft. span, any length. These huts are repaired, painted and completely reconditioned. Prompt despatch. Also other industrial buildings suitable for workshops, stores, garages, canteens, offices, etc. Write, phone or call for details: J. Thorn and Sons, Ltd., Box 138, Brampton Road, Bexleyheath, Kent. Phone, Bexleyheath 305. zzz-239

50,000 map cases, from which can be cut two celluloid sheets 1 ft. 4 ins. by 1 ft. Carbot, Ltd., 201-205 Long Lane, London S.E.1. Phone, Hop 1762. 138-x5333

Extra sales appeal for your products, the Spraytex process, fabric spray finish for most surfaces, including metal, wood, paper, may double the sales of suitable products in both home and export markets. Write for brochure. Dept. H, Spraytex (Manchester), Ltd., 168 Oxford Road, Manchester, 13, or phone Ardwick 2474 or 1548. 141-430

Manufacturer interested in purchasing outright or an interest in moulding business concentrating on bottle closures. Box 6253, care of "Plastics." 137-23

For sale at clearance prices, the following plastic articles:—

90 gross sandwich trays.
20 gross torches.
300 gross side combs.
70 gross crumb sweep sets.
100 gross pairs shoe trees.
35 gross coat hangers.
15 gross condiment sets.

Write Box 6258, care of "Plastics." 137-19

Offers wanted for cup, saucer and plate sets, approximately 35 gross in assorted pastel shades of translucent urea material. Very suitable for Xmas trade. Best offers accepted. Box 6262, care of "Plastics." 137-15

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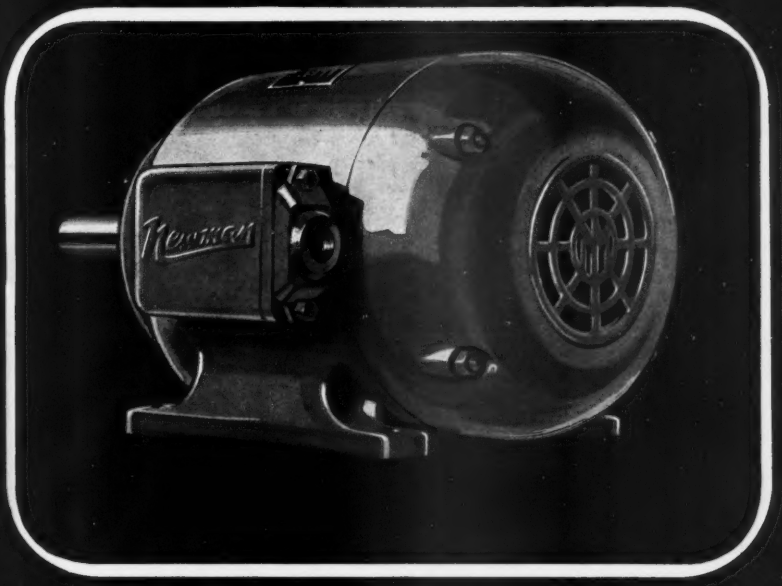

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